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# BUREAU OF PUBLIC WORKS

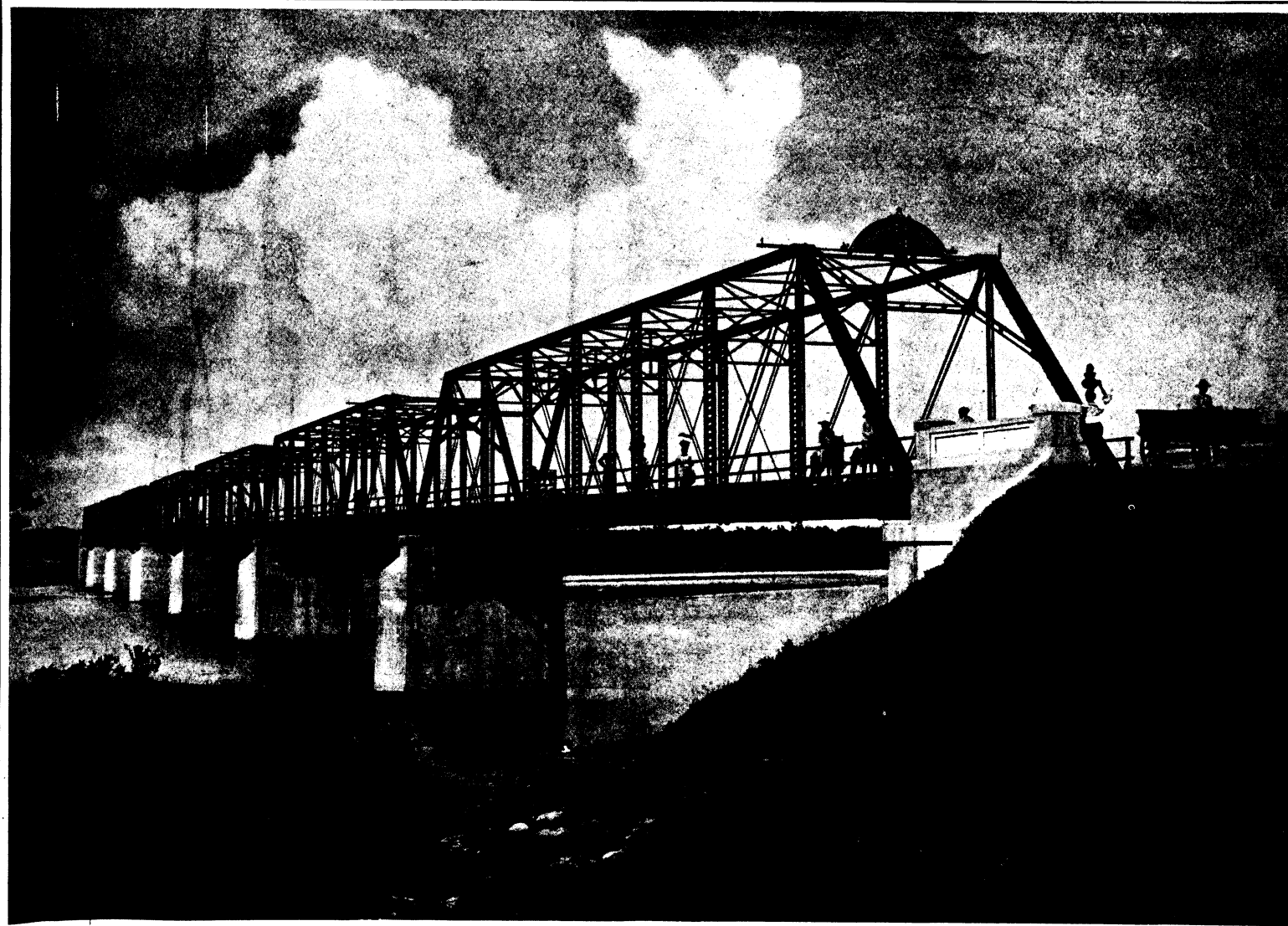


## Quarterly Bulletin

VOL. 3

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No. 3



# QUARTERLY BULLETIN

BUREAU OF PUBLIC WORKS  
MANILA, P. I.

ISSUED QUARTERLY BY  
THE CONSTRUCTING DIVISION, UNDER THE DIRECTION OF  
THE DIRECTOR OF PUBLIC WORKS

C. A. TANSILL, COMPILER OF STATISTICS

The objects of the QUARTERLY BULLETIN are:

1. To show each engineer and employee of the Bureau of Public Works the work of the Bureau as a unit.
2. To show him that his work is a unit part of the whole.
3. To make clear to every provincial and municipal official and to the people the work being done by the Bureau.
4. To make the work of the Bureau of personal interest to all.

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## ROAD PRIZES.

To encourage the construction and maintenance of first-class roads and to create a healthful emulation among the provinces, the Honorable the Secretary of Commerce and Police allotted the sum of ₱30,000 from the funds appropriated by Act No. 1837 for road prizes, to be awarded for the fiscal year ending June 30, 1910; the award to be made by a road committee appointed by the Secretary of Commerce and Police, who outlined the duties of such committee.

The first prize, in the sum of ₱10,000, "to the province which has the most extensive and best maintained system of first-class roads," was awarded to Pangasinan Province, and the funds were expended upon what is known as the "Prize Bridge," bridge No. 37.8 on the Lingayen-Camp One Road. The bridge is a 15-meter span reinforced-concrete arch and was erected at a total cost of ₱9,110.92, exclusive of back fill.

The second prize, in the sum of ₱10,000, "to the province which has made the biggest investment for roads in proportion to its resources," was awarded to Laguna Province, and the funds were expended upon the maintenance of designated first-class roads.

The third prize, in the sum of ₱10,000, "to the province which has established the best system of maintenance of second-class roads," was divided between the Provinces of Ilocos Norte and Ilocos Sur; ₱5,000 being awarded to each province. Ilocos Norte expended her portion of this prize upon the construction of the San Nicolas-Batac first-class road. Ilocos Sur supplemented provincial funds and completed the Pandan Bridge, which was built at a total cost of

₱19,838.63. Pandan Bridge is a single 80-foot steel span with a clear roadway of 4.3 meters.

For the fiscal year ending June 30, 1911, the road committee made some slight modification to the terms under which the prizes would be awarded and adjusted the amount of the prizes. The first prize, ₱15,000, "to the province having the best maintenance records," was awarded to Cebu Province. This prize money was used for the construction of the Danao River Bridge, a five 7-meter slab and girder span bridge on concrete pile bents, and a balance of ₱2,000 was used in the construction of the Macambusine River Bridge, which is a three 12-meter slab and girder span bridge on concrete piers and abutments.

The second prize, ₱10,000, to be given to the province "which actually constructs the greatest number of kilometers of first-class roads from July 1, 1909, to June 30, 1911," was awarded to Albay Province. During this period Albay constructed 36.6 kilometers of first-class road. The road prize money was used for the maintenance of designated first-class roads, which, supplemented by provincial funds, made available a total of ₱71,584.07 for the maintenance of 122.3 kilometers of road, or an average of ₱585 per kilometer per year.

The third prize, ₱5,000, to be given "to the province actually transferring to the road and bridge funds the greatest per cent of road and bridge funds from the general funds of the province and the municipalities of the province," was awarded to La Union Province. The sum of ₱20,000 was transferred. This sum represented 36 per cent of the road and bridge fund. This money was spent on the construction of the Bauang-Naguilian Road.

For the fiscal year ending June 30, 1912, the road committee again made slight changes in the conditions under which the prizes would be awarded. The first prize, in the sum of ₱15,000, "to be given to the province having the highest maintenance rating for first-class roads," was awarded to Leyte Province, which money was spent in reconstructing a section of the Palo-South Road, which had been damaged by storm and flood during the months of October and November, 1912.

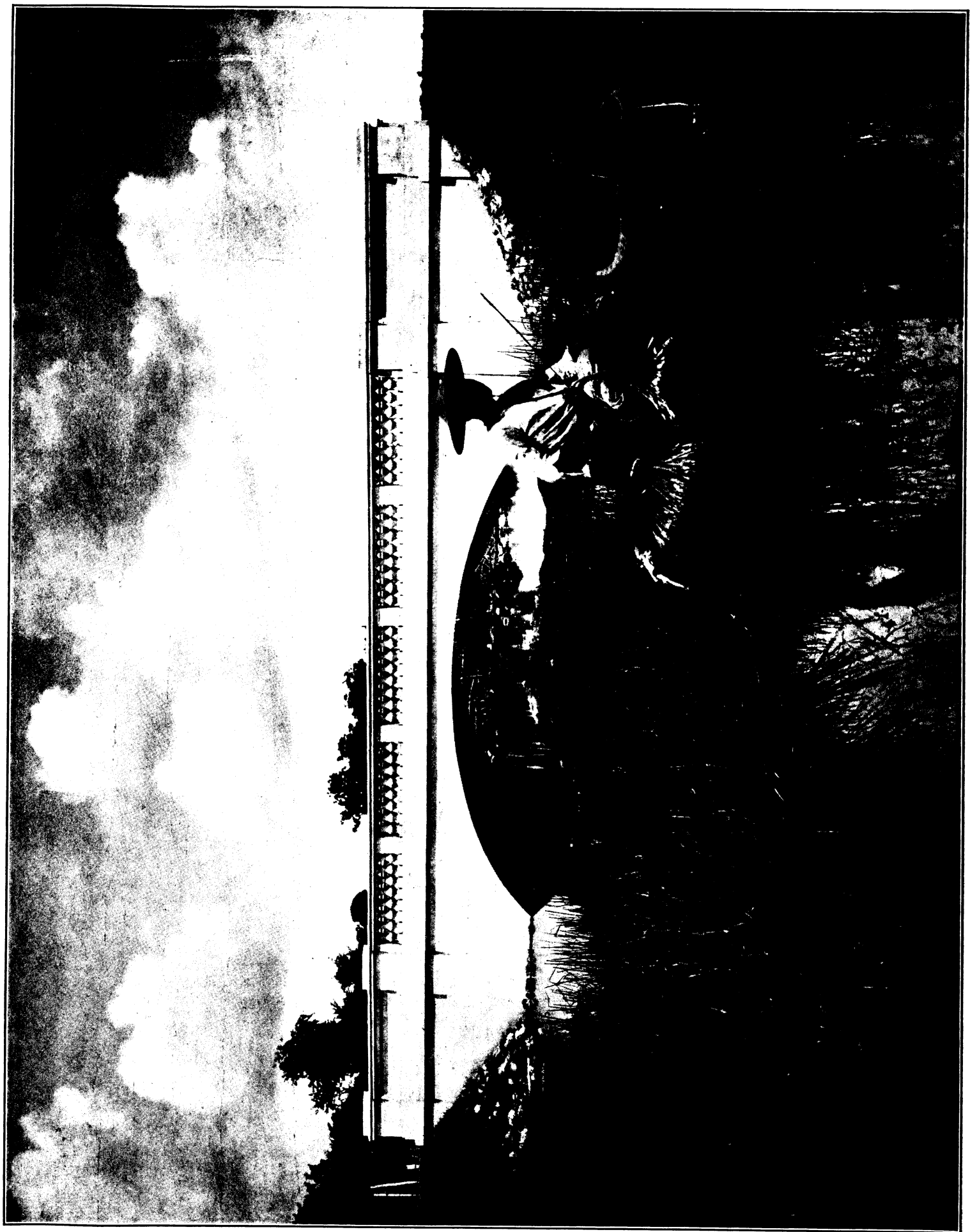
The second prize, in the sum of ₱10,000, "to be awarded under the same conditions governing the first prize, to the province securing the second highest rating" was awarded to Ilocos Norte. This money was expended by the provincial board upon the Road Prize Bridge on the San Nicolas-Batac Road. (See supplement sheet.)

The third prize, in the sum of ₱5,000, "to be awarded to the province actually transferring to the road and bridge funds the greatest per cent of road and bridge funds from the general funds of the province and the municipalities of the province," was awarded to Albay Province. Albay transferred ₱46,287.80, or 65 per cent, of the road and bridge fund. The money was expended in the maintenance of designated first-class roads, which, when supplemented by provincial funds, made available a total of ₱99,874.14 for the maintenance of designated first-class roads for the fiscal year of 1913, or a total of ₱766 per kilometer.

For the fiscal year 1913, which corresponds to the calendar year, from the funds appropriated by Act No. 2264, ₱30,000 was again made available, and the first prize, in the sum of ₱15,000, "to be awarded to the province having the highest maintenance rating of designated first-class roads" was awarded to Pangasinan Province, and the money will be expended for the construction of a bridge across the Toboy River, kilometer 49.5 of the Lingayen-Tayug Road. The borings have been finished at the bridge site and the project will shortly become active.

The second prize, in the sum of ₱10,000 "to be given under the same conditions governing the first prize for the province securing the second highest rating," was awarded to Leyte Province, and the money will be expended on the maintenance of designated first-class roads.

The third prize, in the sum of ₱5,000, "to be given to the province having transferred to the road and bridge funds the greatest per cent of its road and bridge funds from the general funds of the province and from the municipalities of the province," was awarded to Occidental Negros. The sum of ₱38,000 was transferred, representing 22 per cent of the road and bridge fund. The prize money has



Prize bridge, Laoag, Ilocos Norte Province.



been appropriated for the construction of an ornamental reinforced-concrete girder bridge, consisting of one 7-meter and two 6-meter spans over the Tabigui River in the municipality of Saravia on the Bacolod-North Road, the bridge being known as the Prize Bridge. Plans for the bridge have been completed and work will shortly be under way.

The prizes awarded to the provinces have been instrumental in creating an active interest among all officials, and the third prize awarded during the fiscal years 1911, 1912, and 1913, secured a large transfer of general funds to assist in road construction and maintenance, and in addition private contributions for the construction of the Imbang Bridge totaling ₱7,000 and private contributions for the construction of the Maragadang Bridge totaling ₱1,115.40, were received, testifying to the great public spirit of the citizens of Occidental Negros.

The cost of the completed bridges mentioned above include all supervision, overhead, and all other charges for the administration of the central office of the Bureau of Public Works.

A number of prizes to be awarded to the road foremen (capataces) and road men (camineros) in each of the provinces which have designated first-class roads have also been authorized and these prizes are awarded under rules formulated by the road committee, the award to be made by a local committee in each province, consisting of the provincial governor, the provincial treasurer, and the district engineer.

The awarding of road prizes under the rules formulated by the road committee has justified the expectations of the promoters of this system of emulation and healthful competition between the various provinces in road construction and maintenance.

The Director of Public Works is chairman of the road committee with the following members: Hon. Galicano Apacible, chairman of the Committee on Public Works, of the Philippine Assembly; Hon. Melecio Severino, chairman of the Committee on Agriculture, of the Philippine Assembly; and the Hon. Ignacio Villamor, Executive Secretary.



### THE GILBERT BRIDGE AT LAOAG, ILOCOS NORTE.

By W. F. Root, District Engineer.

[See title-page for completed bridge.]

At present, this bridge is worthy of note for two reasons—it is practically at the northern terminus of the Manila-North Road, and is the longest highway bridge in the Philippine Islands. Besides the steel structure, which is 1,120 feet long, the south abutment has a trestle approach 324 feet in length, and there is a “spillway,” as it is commonly known, reaching from the south end of the trestle to the high-water south bank of Laoag River, 1,675 feet. The total width of the river, therefore, at the bridge location is 3,119 feet, or 950.7 meters. The spillway is simply a road fill covered and protected with asphalt macadam and reinforced concrete, and although it may not be a part of the bridge itself, it performs the most important function of a bridge—that of providing free passage for traffic.

Ilocos Norte's revenues for road and bridge purposes are only about ₱70,000 per annum, and she has 58.2 kilometers of first-class road to maintain, yet she cheerfully assumed about ₱125,000 of the total cost of the bridge—but she needed that bridge. Eleven of her 13 municipalities must use the bridge in order to reach either the provincial capital or the principal seaport of the province, and for 2 of them—Laoag and San Nicolas—the bridge makes continuous the single street connecting the two plazas, only 3,000 meters apart.

There was a bridge across the river at Laoag in Spanish times, but little of its history, proportions, or plans can be ascertained at this time. Four of the old masonry piers yet remain, their tops just showing above extreme low water, almost exactly beneath the present

structure. The masonry is brick and rubble, laid up in lime mortar which still possesses a hardness almost equal to that of Portland cement mortar, said to be due to the juice of sugar cane which was used instead of water in mixing the mortar. In excavating for one of the new piers a Mexican dollar bearing the date 1827 was found embedded in the old masonry. This date checks fairly closely with local tradition regarding the date of construction.

The old pier foundations were approximately 10 meters apart, center to center, the spaces between them having been protected against scour by brick and rubble aprons. The bridge was never completed as a permanent structure, but each year the upriver municipalities were required to send down consignments of timber and bamboos, from which a temporary bridge would be put together on the masonry piers to last until the annual rainy season floods took it out. The public-spirited provincial governor would have completed the projected bridge, utilizing the fifteen days compulsory labor required each year of all the able-bodied men of the province for roads and bridges, but orders from Manila diverted this labor to the construction of buildings and other public works. For many years before the inception of the present splendid structure, the only means of crossing the river was by a rather primitive and wholly inadequate balsa (ferry) system.

#### LOCATION DATA.

The first location surveys were made in October, 1910, and consisted of a topographic survey of the bridge site, certain borings to ascertain the nature of the foundations, some investigations of the old piers, etc. As the location plan (fig. 2) shows, the main channel of the river runs close to the north bank and is about 350 meters wide. By reference to the contours shown on the location plan, in connection with the high-water elevations shown in figure 3, it will be seen that all the rest of the river section is subject to overflow even at ordinary flood stages.

The entire surface from the south abutment to the south bank is composed of sand, so soft as to make travel through it extremely difficult. The bed of the main channel is sand and gravel, the latter predominating near the north bank. Preliminary borings, and later an artesian well on the Laoag side, showed the surface sand and gravel to be underlaid with a blue sandy clay, which extends without a break to unknown depths. Practically the same formation had been encountered in bridge foundations at San Mateo, 5 kilometers up the river from Laoag.

In July, 1911, there occurred a very destructive flood in the river. The water covered the entire country between Laoag and San Nicolas, reaching depths of 5 meters in places, the current in the main channel attained extremely high velocity for a meandering river, and there was a large amount of heavy drift. This flood had considerable bearing on the final design of the bridge, chiefly on account of the extensive erosion suffered by the south bank of the river in a deep bend some 1,500 meters upstream from the bridge site. There had always been a few skeptics, both lay and professional, who were inclined to the opinion that the whole project was a gamble on the river's “staying put” long enough even to demonstrate the utility of the structure—with the odds against the bridge. However, it seemed unlikely that there would ever be any better chance for the river to forsake its present bed than this inundation afforded, at least during the life of a steel bridge.

#### DESIGN.

Some preliminary studies for the determination of the economical span length were made in November and December, 1910, but, since no funds could be made available at that time, the project remained in abeyance until 1912, at which time Vice-Governor Newton W. Gilbert obtained for the province a loan of ₱100,000 and the promise of a special allotment of ₱100,000 additional. On account of his successful activities in favor of the project, the provincial board of Ilocos Norte very properly named the bridge for him. It was first proposed to build a light highway bridge, designed to carry an 8-ton steam roller as live load, but on piers and abutments heavy enough to carry a bridge of standard live-load capacity. This standard loading, adopted by the Bureau for ordinary highway bridges, is

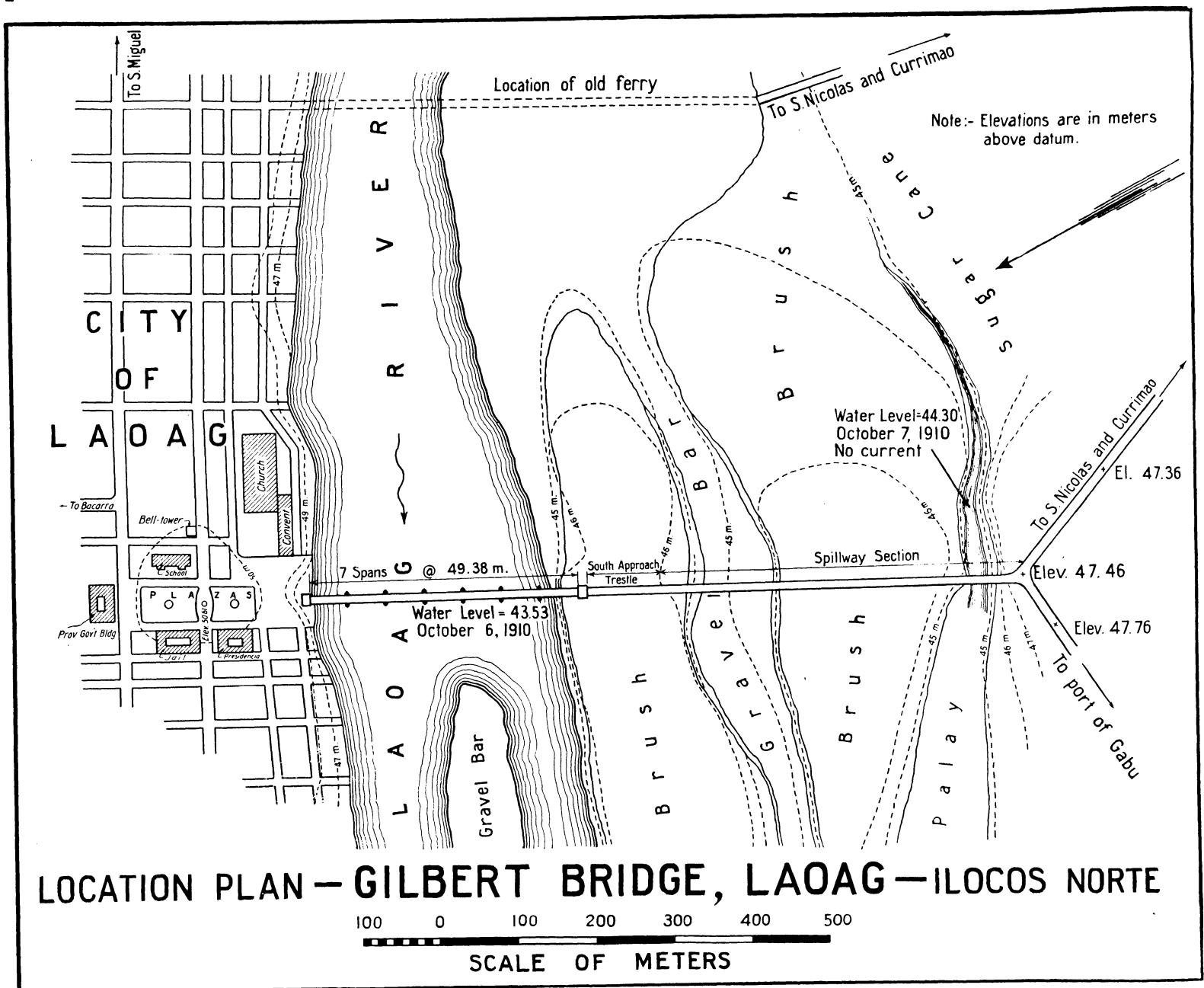


Fig. 2.

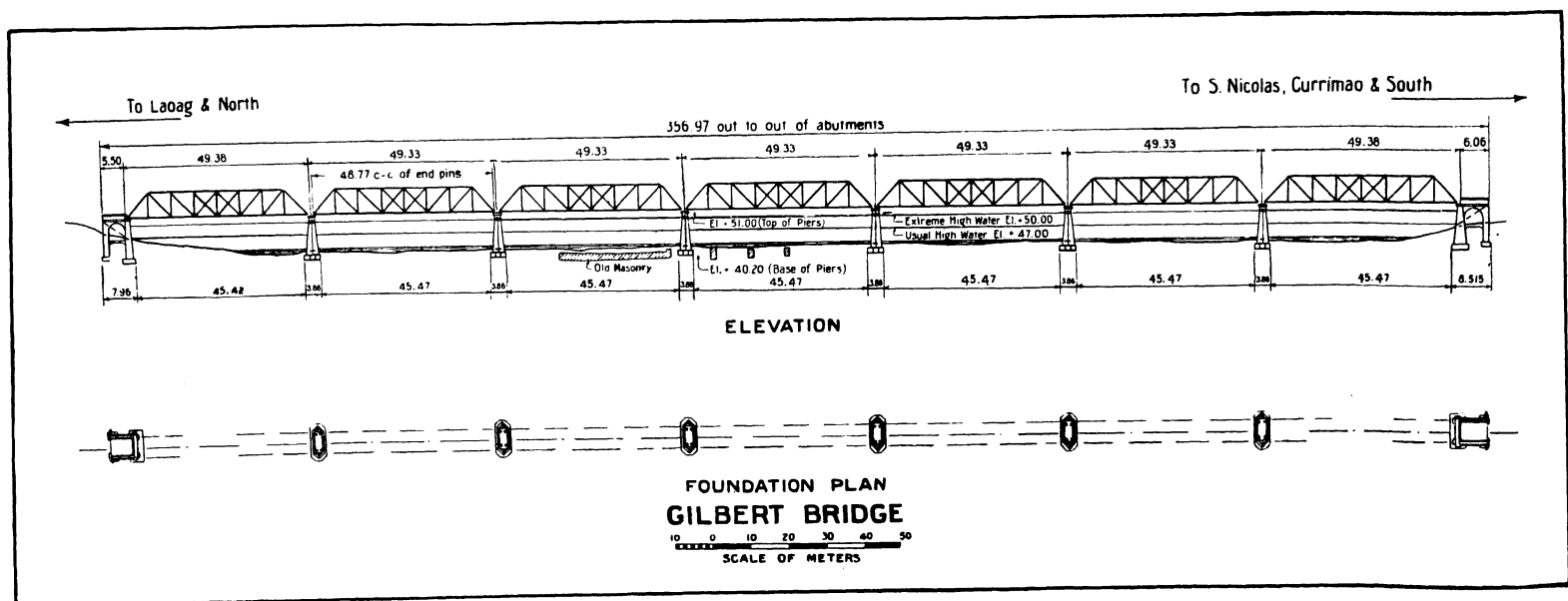
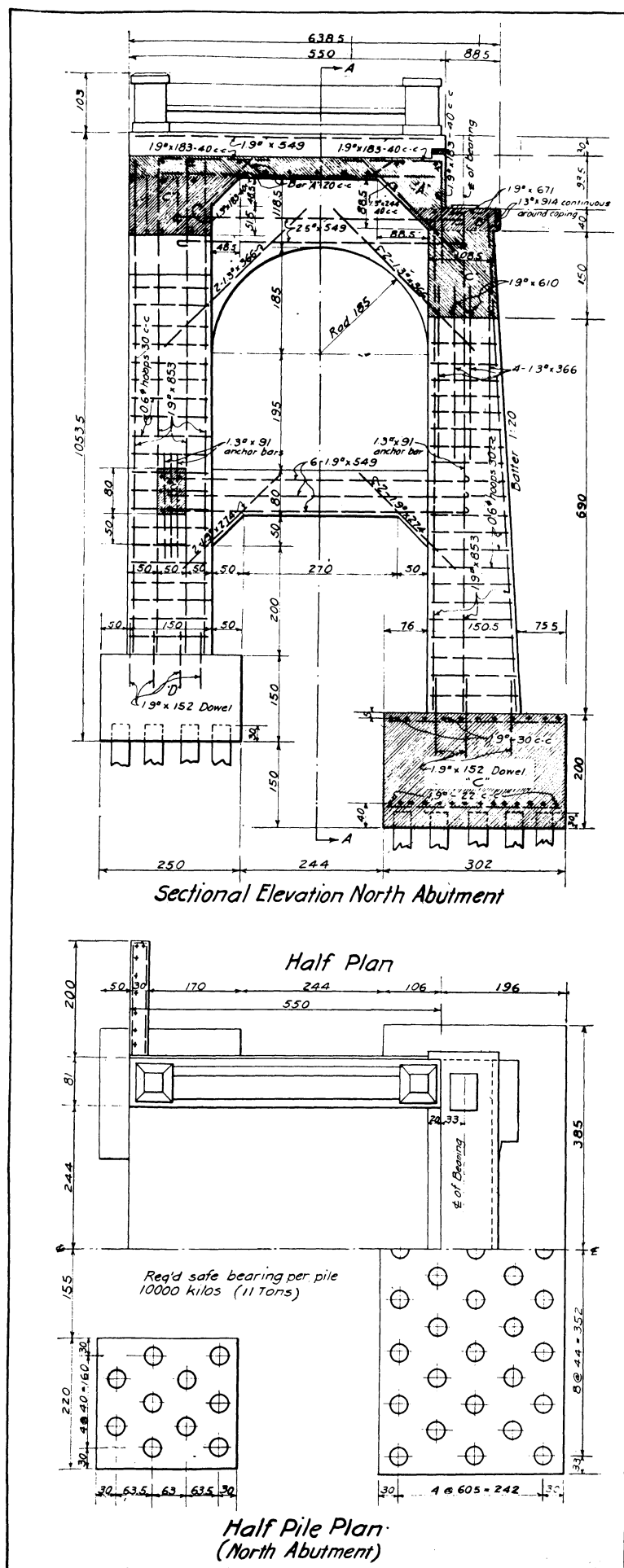


Fig. 3.



15-tons equally distributed over two axles on 10-foot centers, with wheels set to 5-foot gauge, for the floor system, and 63 pounds per square foot of the entire roadway, with this span length, for the trusses. It was discovered that a bridge designed for the standard loading would cost but little more than the light bridge on the heavy substructure, and this consideration, together with the practically certain knowledge that traffic over the bridge would increase enormously, finally determined the choice of the heavier design. The preliminary studies had indicated that the economical length of span would be 160 feet, and that seven spans would be required to reach across the channel. The stress sheet was worked out by the Bureau on the basis of the standard live loading, and with the following general specifications:

	Feet.
Length of span.....	160
Width center to center of trusses.....	18
Clear width of roadway.....	16
Depth of truss.....	22
Clear headroom.....	14

Type: Through Pratt truss, 8-panel, pin-connected

The floor beams are 20-inch 65-pound I-beams riveted to the vertical web members, and the stringers are 12-inch 31.5-pound I-beams. To the stringers are bolted the 3 by 6-inch nailing strips, and to these are nailed the 3 by 8-inch floor planks of palugapig, yacal, and pagatpat. The lower chord members at each end of the truss are designed for compression also, to accommodate a considerable reversal of stress due to wind pressure.

The contract for furnishing the fabricated steel was secured by the American Bridge Company of New York. The company prepared the detail drawings and fabricated the material in their plant at Ambridge, Pennsylvania.

Complete plans for the substructure were prepared by the Bureau. The typical abutment design is shown by figure 4. This design is especially appropriate for the south abutment, since it permits the bridge to be lengthened readily, by simply adding further spans, to accommodate the channel should it ever show a disposition to move southward. The same design is used for the north abutment, partly for the same reason. The abutments are of reinforced concrete. The piers are of the ordinary design for plain concrete, as is shown by title-page. Both piers and abutments rest on wooden piles, cut off 2.2 meters below mean low water. The piers were originally designed with bridge seats 9 meters above mean low water, thus giving a clearance for the lower chords of 1.7 meters above high water. This height of pier was later cut down 70 centimeters.

#### CONSTRUCTION.

The contract for the substructure was signed in December, 1912, the price being ₱63,000, subsequently reduced to ₱61,200 on account of the change in pier height noted above. The work occupied thirteen months, from January, 1913, to February, 1914. The contractor's procedure at each pier and abutment was to build a cofferdam of timber sheet piling around the work, excavate by pick and shovel methods to grade, drive and cut off the piles, and start the concrete footings 30 centimeters below the heads of the piles. One large centrifugal pump was sufficient to keep the excavation unwatered in all the cofferdams except the one for pier No. 1, next to the north abutment, for which two pumps were necessary, as the water stood 1.5 meters deep on the outside of the cofferdam at this point.

The foundation piles were driven with a steam drop-hammer driver, assisted by the water jet. A follower was used with each pile to enable it to be driven to grade. No difficulties were encountered in the driving, except at pier No. 1, where two or three piles apparently struck some of the old Spanish masonry. A 3-inch wrought-iron pipe was easily driven through the hard stratum, but could not be pulled out afterwards. This pier is near the point of maximum velocity at flood stages, and, on account of the possibility of scour, is being watched closely. The pile foundation eliminates any serious danger, although future developments may indicate the necessity of protective riprap.

All concrete was mixed and placed by hand, the work being done largely by the Ilocano women. They handled all the sand and gravel



and a large portion of the mixed concrete, besides performing a good deal of the labor of mixing.

The contract for the delivery and erection of the steel superstructure was signed February 4, 1914, the fabricated steel arrived in Manila about February 20, the work was begun immediately, and was completed in June, 1914. Erection was started at the north abutment

and proceeded by consecutive spans. A single traveler was used, and sufficient false work for three spans at a time.

It was at first intended to use palugapig flooring, cut and sawed in the northern part of the province of Ilocos Norte, and a contract for furnishing this flooring was signed in July, 1913. However, owing to considerable difficulty in obtaining sawyers and in getting a mill

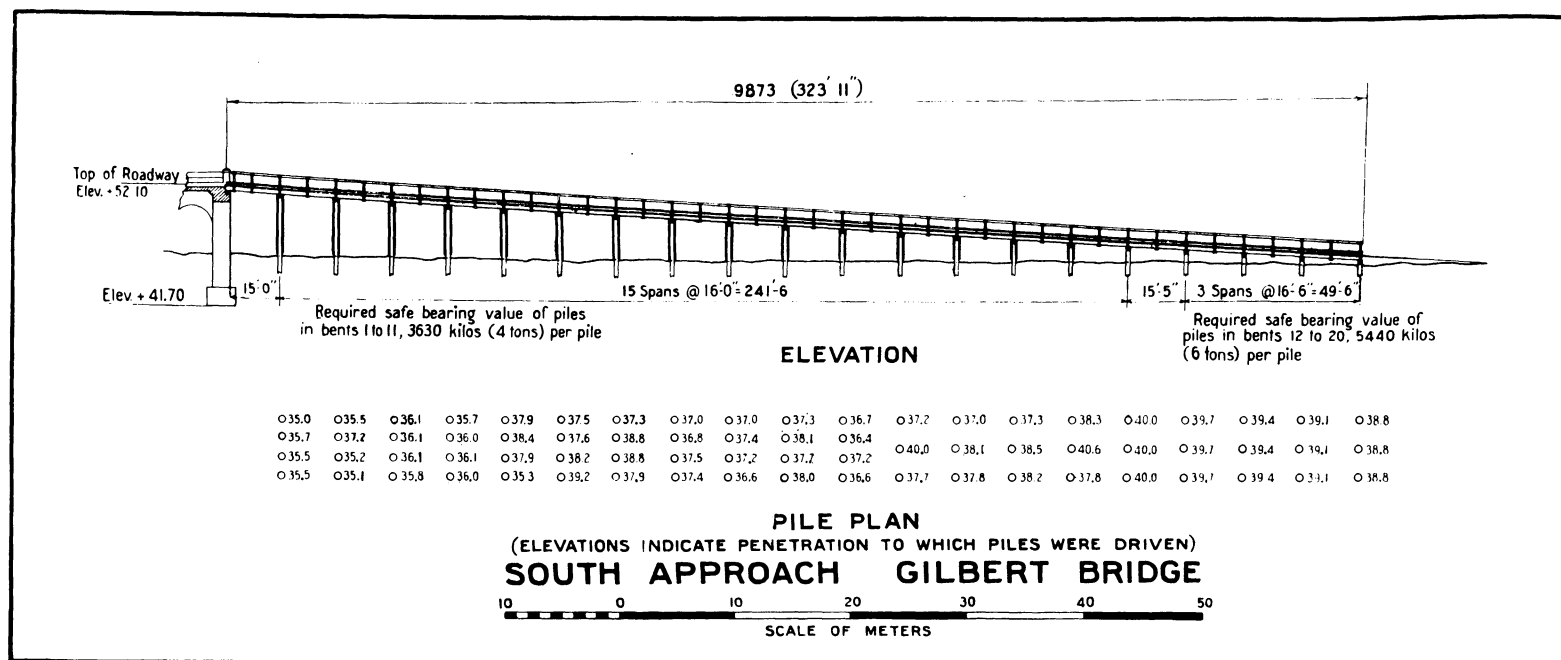


Fig. 5.

The Gilbert Bridge—Project No. 11.

	Estimate.			Actual cost to Government.			Contractor's unit cost.
	Quantities.	Unit price.	Amount.	Quantities.	Unit cost.	Total.	
Excavation:							
(a) Abutments—							
Above mean low water .....	300 cubic meters	P1.00	P300.00	300 cubic meters	P0.92	P276.00	P1.90
Below mean low water .....	306 cubic meters	6.00	1,800.00	1,100.14 cubic meters	5.48	6,028.80	6.12
(b) Piers (below mean low water) .....	800 cubic meters	6.00	4,800.00				
Filling (approaches beyond outside of abutments not included) .....	500 cubic meters	1.00	500.00				.55
Piling:							
(a) Abutments (140.7 meters long) .....	980 linear meters	3.50	3,430.00				
(b) Piers (378.7 meters long) .....	2,646 linear meters	3.50	9,261.00	3,626 linear meters	3.22	11,675.72	2.56
Concrete:							
Class A (1:2:4) .....	33.1 cubic meters	35.00	1,158.50	33.60 cubic meters	32.20	1,081.92	27.65
Class B (1:2.5:5) .....	53.2 cubic meters	30.00	1,596.00	48.40 cubic meters	27.60	1,335.84	20.43
Class C (1:3:6) .....	256.8 cubic meters	28.00	7,190.40	2,202 cubic meters	25.76	56,663.52	15.31
Class D (1:3.5:7) .....	356.1 cubic meters	25.00	8,902.50	355.80 cubic meters	23.00	8,183.40	7.65
Steel reinforcement	8,301 kilograms	.18	1,494.18	8,250 kilograms	.165	1,357.12	.11
Balustrades or hand rail: (11.56 linear meters of bridge) .....	11.56 linear meters	25.00	289.00	11.56 linear meters	22.80	263.56	18.18
Miscellaneous .....						434.12	
Structural steel .....	362,000 kilograms	.331	119,822.00				
Flooring (not including metalting) .....	70.1 M board feet	250.00	17,527.00	24,739 M board feet	100.00	2,473.90	
				45,000 M board feet	150.61	6,777.50	
Inspection and contingencies .....			206,068.58				
			6,000.00				
Total estimated cost, excluding engineering .....			212,068.58				
6 per cent Bureau of Public Works charges (cost of preparing plans, division engineers charges, and Bureau of Public Works office expenses) .....			12,724.11				
7 per cent district charges (cost of field investigations, district engineer's office, and inspection charges) .....			14,844.80				
Total .....			239,637.49				
9½ per cent Insular aid .....							
Total actual cost including Insular aid .....							
Substructure .....							
Superstructure .....							
Total (inspection and surcharges not included) .....							

<sup>a</sup> Contract with Daniel Galza for the construction of the substructure, including P400 cost of extra work.

<sup>b</sup> Contract with the Atlantic, Gulf and Pacific Company of Manila for erection and painting of the steel superstructure.

<sup>c</sup> Contract with the American Bridge Company, through the Insular Purchasing Agent, for the fabrication of the steel.

<sup>d</sup> Part of contract under (b) for placing the timber floor.

<sup>e</sup> Contract with W. A. Wren for furnishing and transporting to bridge site, of 24,739 board feet of flooring.

<sup>f</sup> Cost of flooring purchased from Insular Purchasing Agent, including P556.79 for transportation from Currimao to bridge site.

NOTE.—This estimate does not include any work on the approaches or metalting over the structure.



set up and started, the contractor was unable to complete his contract in time for the opening of the bridge in July, 1914, so that about 45,000 board feet of the flooring had to be obtained through the Purchasing Agent, Manila.

The south approach to the bridge is a timber trestle, each bent consisting of four or three piles (see fig. 5), strongly braced and capped with a 12 by 12-inch pile cap. All timber except the piles is Oregon pine. Later, if the river shows no disposition to leave its present channel, it is intended to replace the trestle, either with a structure of reinforced concrete or with an earth fill, whichever seems best suited to the conditions then existent.

The "spillway," or overflow section, extends from the trestle approach to the San Nicolas shore, a distance of 510 meters. An embankment was built to a level grade and with slopes of 1 on 1 and 1 on 5 for the upstream and downstream sides, respectively, and thoroughly rolled. Clay was mixed with the sand to give it binding power. This subgrade was surfaced with asphalted gravel, and both slopes were protected by a 10-centimeter layer of concrete, reinforced with barbed wire. A section of 40 lineal meters, located in the depression (see fig. 2) near the trestle approach, was washed out on August 21, 1914, by a moderate flood. Apparently the failure was due to excessive percolation through the sand and gravel stratum upon which the embankment was built. It is possible that the concrete protection on the upstream slope may have to be carried down, as a kind of core wall, to the blue clay which underlies the gravel. The spillway was constructed as an experiment, which was justified by its low cost, ₱34.67 per lineal meter. If it proves successful, there are a number of other lowland rivers in the Philippines to which this method of treatment may be applied with economy.

The tabulation shown at the foot of page 6 should be of interest, as showing the comparison between estimated and actual costs, and also the contractor's cost data in a number of instances.

#### Appropriations.

Provincial funds .....	₱1,813.02
Insular loans:	
Act 1729 .....	50,000.00
Act 2083 .....	50,000.00
Regular allotment (1912), Act 1988 .....	13,256.50
Special allotment:	
Act 1988 .....	25,000.00
Act 2059 .....	50,000.00
Act 2264 .....	25,000.00
Insular aid .....	12,371.96
<b>Total .....</b>	<b>₱227,441.48</b>

#### Expenditures.

Substructure .....	61,600.00
Fabrication .....	59,756.05
Erection .....	41,950.00
Flooring .....	9,251.40
Pier 5, protection work .....	414.11
Inspection .....	3,683.08
Miscellaneous (including investigations) .....	1,568.58
Surcharges .....	12,344.90
Insular aid .....	12,371.96
<b>Total .....</b>	<b>202,945.08</b>
<b>Balance .....</b>	<b>24,496.40</b>

#### Approaches and spillway.

Feature.	Appr o		Spillway.	Total.
	North.	South.		
1. Subgrade:				
(a) Grading, includes excavation, placing, shaping, etc .....	₱3,585.43		₱2,185.79	₱5,731.62
(b) Rolling .....			341.08	341.08
2. Surfacing, waterbound:				
(a) Hauling and spreading gravel .....	768.07		1,347.78	2,115.85
(b) Rolling .....	393.23		548.81	942.04
3. Surfacing, asphalted:				
(a) Screening gravel, hauling, heating and spreading asphalt, etc .....			4,878.10	4,878.10
(b) Rolling .....			1,403.64	1,403.64
4. Concreting spillway slopes .....			4,031.30	4,031.30
5. Piling (101 piles driven and caps placed) .....		₱5,635.01		5,635.01
6. Stringers and erection .....		4,423.57		4,423.57
7. Miscellaneous .....	9.35	604.11	146.92	760.38
8. Inspection .....	56.98	128.66	180.12	365.76
9. Surcharges, includes Insular aid .....	637.63	1,439.82	2,015.74	4,093.19
<b>Total .....</b>	<b>5,411.09</b>	<b>12,231.17</b>	<b>17,079.28</b>	<b>34,721.54</b>

The formal inauguration of the bridge took place on July 4, 1914. The inauguration address was delivered by the Honorable Clinton L. Riggs, Secretary of Commerce and Police, who, with Commissioner

Singson and a party of important government officials, visited the bridge site for that purpose. The Secretary's automobile crossed the bridge at the head of a procession over a kilometer in length, composed of floats many and various, decorated carriages and automobiles, hundreds of school children in orderly companies, the Ilocos Norte caminero corps (road-maintenance force), Constabulary, municipal police, and last and noisiest, a 10-ton steam roller hidden, all but its whistle, in flags, bunting, and flowers.

The preliminary surveys were made by W. C. West, assistant engineer in charge and later district engineer, and the construction was under the supervision of W. F. Root, district engineer, and D. E. Henry, senior supervising engineer. Daniel Galza of Laoag had the contracts for building the piers and abutments, for the piles in place and capped for the trestle at the south approach, and for the protective piles around the south abutment. W. A. Wiren of Dungon, Ilocos Norte, had the contract for furnishing the timber flooring. Inspection of steelwork while in process of fabrication was by Hildreth & Co., inspecting engineers, New York. Contracts for erecting the steel superstructure and the floor system of the south approach trestle were held by the Atlantic, Gulf and Pacific Company, of Manila.

## PAINT AND PAINTING FOR CONSERVATION.

By GORDON B. CANAGA.

Designing Engineer, Bureau of Public Works.

Associate Member, American Society of Civil Engineers.

That the importance of good workmanship and proper choice of paints as a protection for metal or timber is not sufficiently appreciated can hardly be gainsaid. Painting is not a matter merely of daubing on any sort of pigment and oil—it is a technical problem worthy of careful attention to workmanship and intelligent study of ingredients. It is the purpose of this article to set forth the desired standards of practice in the Bureau of Public Works with regard to painting for the preservation of structures. The subject matter will be taken up in this order: First, painting of steel and iron structures in the fabricating shop and field painting at erection; second, maintenance painting for such structures; third, painting of galvanized surfaces; and fourth, treatment of timber structures for preservation only.

### PAINTING OF STEEL AND IRON.

Steel as it comes into the shop is usually somewhat bent and more or less covered with dirt, grease, rust, and scale. A certain amount of cleaning is necessary for fabrication, so that the steel after being fabricated is rather clean. As a matter of convenience in shop inspection, the painting of the member as a whole is postponed until after inspection. The surfaces are then cleaned of grease, dirt, rust, and scale, and painted with the specified priming coat. It is sometimes difficult to secure thorough cleaning on account of the small inspection force available. Another fruitful source of difficulty is the excessive humidity obtaining in the Philippines. Hence, defective painting is sometimes allowed to get out of the shop, but it will generally show up in time to be corrected in the field by methods which will be gone into later.

The regularly specified paint film and permissible variations therefrom are these:

#### Priming (shop) coat.

Formula:	
Red lead .....	15 lbs.
Asbestine .....	2 lbs.
Raw linseed oil .....	1 gal.

#### Second (field) coat.

Approved graphite (olive green).

#### Third (field) coat.

Approved graphite (natural).  
Finished color, natural graphite (gray).

or

Approved graphite (red).  
Finished color, very dark maroon.

or

Second (field) coat.  
Approved graphite (natural).  
Third (field) coat.  
Approved graphite (olive green).  
Finished color, dark olive green.

An alternative film which is sometimes used, in buildings and in maintenance work, is made up of these three coats:

*"Deco" inhibitive primer (bluish-gray).*

Formula:	Per cent.
Sublimed blue lead.....	63
Linseed oil.....	32
Turpentine drier.....	5

*"Deco" second coat (red).*

Formula:	Per cent.
Bright red oxide of iron.....	85
Red lead.....	10
Zinc.....	5
This pigment ground to a smooth condition in pure linseed oil containing not over 5 per cent turpentine.	

*"Deco" third coat (green).*

Formula:	Per cent.
Pure chrome green.....	30
Lamp black.....	15
Zinc chromate.....	5
Yellow ochre.....	10
Barytes (or silica).....	50
This pigment ground to a smooth condition in pure linseed oil containing not over 5 per cent turpentine.	

The opinion of experts as to red lead varies. They agree that it is at worst neutral, some authorities maintaining that it possesses valuable rust-inhibiting qualities. Commercial red lead contains litharge, an active "drier," or oxidizing agent, which produces the hardening of red lead frequently noticed in packages which have been stored for a considerable time before using. It has been attempted to overcome this tendency by mixing the paint just prior to use, and by using raw linseed oil, which oxidizes less readily than boiled oil. A serious disadvantage is the high specific gravity of red lead which causes it to settle out of the vehicle and, except with good workmanship, gives an unduly high proportion of oil in the priming coat. This difficulty has been overcome to a certain extent by the addition of asbestine (magnesium silicate) which has a tendency to hold up heavier pigments and prevent settling, and has the further advantage of increasing the resistance of the film to abrasion.

The foregoing indicates some of the causes of defective shop painting. However, rusting underneath the paint film, if it occurs at all, will probably have progressed far enough to be distinguishable by rough spots in the paint, while too much oil will cause the lead to streak in drying. Then, too, there are always spots where the paint is rubbed off in shipping and erection. All defective and bare spots as well as heads of field rivets and bolts should be thoroughly cleaned down to "bright" steel, and painted with either of the primers. "Deco" inhibitive primer is preferred, since it may be purchased, ready mixed, from the Bureau of Supply.

It should be noted that only these spots are to be repainted. To paint over the entire structure with either of the primers is a waste of money. Two coats are no better than one, since neither red nor blue lead has any notable resistance to weather or abrasion. If it is felt that the owners of the structure suffer from plethora of funds, their money had best be spent on an additional weather and abrasion resisting outer coat, graphite or "Deco" third coat, as preferred.

In the design of paints for covering and protecting the inhibitive priming coat, there are four essentials, viz:

- (a) High resistance to weather and abrasion.
- (b) Elasticity and tenacity to stand shocks and to follow the expansion and contraction of the structure.
- (c) Good "brushing" and covering qualities.
- (d) The color of each coat must contrast with that of the preceding coat, for ease and certainty of inspection. (For example, the red-lead primer would show through pinholes or streaks in a defective second coat of natural or olive-green graphite, while defects in a red second coat would only be discovered by the closest inspection.)

With any of the combinations outlined, results will depend upon workmanship. Most of the commercial graphite paints satisfy the Bureau's requirements for an "approved graphite paint," but Dixon's "Silica-Graphite" has been more extensively used in the Philippines than have other brands and is readily obtainable. The "Deco" paints are made over formulæ furnished by the Institute of Industrial Research, Washington, D. C., and are obtainable from the Insular Bureau of Supply. For the best results the "Deco" paints must be applied in the specified order. The color of the finished structure is largely a matter of taste and, within the limitations described, is to be

determined locally. However, it is impracticable to specify other than red lead as the shop coat for fabricated steel, and this will confine the use of the "Deco" paints principally to maintenance work.

In field painting of steel, two prime requisites are good workmen and good tools. District engineers will find that any trouble to which they may be put in training painters for structural-steel painting will be amply repaid by the less frequent maintenance painting which will be necessary. The workmen should be equipped with steel brushes for removing dirt and loose rust, and a heavy fiber brush for dusting the surface after it is cleaned. In addition there should be provided a metal scraper for removing the more obstinate rust and scale. For the actual painting they should be provided with heavy round brushes and small paddles for keeping the paint stirred up. In applying the paint care should be taken that the brush is not too full. Paint should be spread out to the thinnest possible film by repeated strokes of the brush. With good workmanship 1 gallon of the paints mentioned will cover 500 square feet with one coat. If painters use more than this it means not only a waste of paint but, what is more detrimental, careless workmanship and insufficient brushing. Thorough brushing is necessary for two reasons: First, to increase the adhesion of the paint film to the steel or to the coat below, and, second, to prevent curling which results from too thick a film of paint. It will be remembered that linseed oil hardens by oxidation, and therefore from the outside inward. Hence the necessity for a thin film. While not an absolute panacea, "Less paint and more painting" is a prescription which will cure the larger number of painting troubles.

Given properly selected materials and thorough workmanship, there remains one condition which must be fulfilled if a durable job is to result. *Painting must not be done except in dry weather.* One district engineer states that he finds it necessary to keep a painting gang continuously at work in order to paint all of his structures once each year. However, were he able to secure paint films of normal durability, the number of square feet of repainting would be reduced by two-thirds, since paint should last three years. A good graphite paint is one of the most waterproof films in use, while red lead is far from being impermeable. Hence the importance of a dry surface for applying the graphite paint. The present specification prohibiting painting in damp weather has a sound and logical basis and is one of the cases where practice must be modified to suit specifications and not where specifications may be interpreted to accommodate practice. It is much better practice to allow steel to stand unpainted through part of one wet season and then paint in dry weather than to attempt painting in damp weather.

#### MAINTENANCE PAINTING OF STEEL AND IRON STRUCTURES.

The best paint, no matter how well applied, will deteriorate to such an extent as to require repainting in from two to four years under the climatic conditions obtaining in the Philippine Islands. Structures should be inspected at regular and frequent intervals, and maintenance painting carried out on the principle that "a stitch in time saves nine." If the film shows evidences of general disintegration, the entire surface should be thoroughly cleaned of old paint and rust and repainted, since the conditions warrant the inference that unsuitable materials have been used or that the workmanship throughout is poor.

It will more often be found that much of the paint film is intact and the steel underneath free from rust. The difficulties of good workmanship are such that even a first-class paint film will show weak spots where disintegration will start. Such spots must be thoroughly cleaned, but there is no excuse for removing an assuredly good paint film and replacing it with one that cannot, at best, more than equal that removed. After cleaning, bright steel should show, with a narrow band of the original primer all around the edge. The exposed spots should then be painted with "Deco" inhibitive primer and the usual weather-resistant outer coats. The treatment of the remainder of the surface, i. e., the portion where the old film is intact, will depend upon the *surface condition* of the paint. If it has stood for considerable time and is "dusting," all dirt and disintegrated surface paint should be removed with a stiff brush and two coats of graphite or "Deco" (second and third coat) paint then

be applied. On the other hand, if the painting is comparatively new and in apparently good condition, it may well be allowed to go without more work than touching up the defective spots as before indicated.

When necessary to remove paint from metal or wood surfaces, a gasoline torch—also care and common sense—may be used to burn the linseed oil of the film so that the paint may be more readily removed.

In maintenance painting, the same requirements as to workmanship and weather conditions apply as in the original painting. Thorough cleaning away of all rust and disintegrated paint is of the utmost importance.

#### PAINTING OF GALVANIZED-IRON SURFACES.

To properly understand this subject a certain knowledge of protection by galvanization is requisite. If the hypothesis that corrosion is due to electrolysis be admitted, it follows that steel or iron may be protected by coating with another metal electropositive to it. Of the metals which practically may be used for protecting iron or steel, zinc is the most electropositive. Iron or steel sheets are galvanized by the "hot-dip" process, there being present in the zinc used for galvanizing small percentages of iron, lead, and tin. An excess of iron renders the galvanization brittle, while an excess of lead does not dissolve in the galvanizing bath and segregates, forming weak spots in the surface. Tin is electronegative to iron and, except in minute quantities, is undesirable. (The electronegative character of tin explains the rapid corrosion of tinned iron sheets after the coating has been scratched through.)

When two metals are placed in contact, the electronegative metal is protected at the expense of the electropositive one. It follows, therefore, that the best galvanizing coating will in time lose its effectiveness, and it becomes desirable to erect an additional barrier against the weather by a suitable paint film. A careful consideration of the characteristics of the galvanizing coating will indicate the absolute uselessness of an inhibitive paint as a primer. There will be spots where the galvanizing is broken either by bending during the fabrication of louvers, gutters, down spouts, and the like, or by rough handling in the field. Such spots should be painted with an inhibitive priming coat, but the surface in general requires no such treatment.

The application of paint to a galvanized surface in such manner as to insure its adhesion has always been recognized as one of the most difficult problems confronting the master painter. There are various methods of roughening the galvanized surface, which possesses a peculiar greasy nature, but all of these are unsatisfactory makeshifts. Among others may be mentioned washing of the surface with dilute acids, such as muriatic or acetic (common vinegar), or acid salts, such as copper acetate. All of these achieve the purpose indicated and in the absence of a better method may be used. However, it seems a waste of otherwise useful funds to pay for a heavy galvanizing coat and then to remove a portion of it. When necessary to use any of these methods, there are two precautions to be observed: First, use the most dilute solution that will be effective; and, second, after applying the roughening agent wash the surface thoroughly to remove all traces of the same. This effect may also be obtained by allowing the galvanized surface to weather from four to six months, during which period a portion of the zinc oxidizes, the desired roughness of surface being thus obtained.

As indicating a method both correct in theory and usable in practice, the following is quoted from "Corrosion and Preservation of Iron and Steel," Cushman and Gardner, page 207:

That these preliminary treatments are wrong in principle and quite unnecessary in practice, when proper paints are selected, is the firm conviction of the authors. The metals should, as a matter of fact, be given a priming coat of a sharp-toothed siliceous pigment ground in varnish. This should be well brushed onto the metal, so that the sharp angles of the pigment will form a union with the zinc surface. In short, the varnish serves the purpose of closely cementing the pigment to the zinc. In addition to the sharp pigment, a certain proportion of a soft pigment, such as sublimed or corroded lead, is believed by some experts to be beneficial. Subsequent coats of paint of any desired formula may be applied, provided the first or priming coat is properly designed.

The Bureau of Public Works for some time has been endeavoring to secure a primer for galvanized surfaces designed along these lines, but it must be confessed that scant success has attended these efforts, nothing of the sort being yet available locally.

The nature of the galvanized surface and the difficulty of so applying a paint film that it will adhere, make thorough brushing doubly important in this class of painting.

#### PROTECTION OF TIMBER STRUCTURES.

Timber deteriorates principally from two causes: First, the attacks of vegetable parasites which become evident as dry rot, etc.; and, second, the attacks of insects and other borers. There are certain timbers which are more resistant to attacks of both classes, their resistance being due to either hardness and density or their content of resins or other natural preservatives. Among others, there are two methods for retarding deterioration, each of which simulates one of these phenomena. The first consists of applying an impervious film (paint) to the surface, thereby keeping out vegetable parasites. This method, of course, is applicable only to timber whose moisture content has been minimized by proper seasoning and which has not been already attacked. For timbers where the appearance is of secondary importance we may disregard this method in favor of the second, which consists in the artificial impregnation of the timber with substances preventing decay and tending to discourage boring insects. Creosoting is one of the best solutions of this problem, but it is not available in the Philippine Islands. A fairly efficient substitute is painting with carbolineum. This is of some what the same nature as creosote, but, being applied with a brush instead of under pressure, is correspondingly less effective.

It is fortunate, however, that among the more common native timbers of the Philippines there are many which are practically immune to rot even when in contact with moist earth, and a larger variety which last well if kept away from earth. Intelligent choice of structural timbers, having reference to the conditions under which they are to be used, and to the strength required together with careful designing in the matter of providing air spaces at the end of beams, etc., will insure satisfactory life of structures. Probably the most reliable guide in the choice of structural timbers is Bulletin No. 11 of the Bureau of Forestry (issued 1911). In design it is of course impossible to eliminate all contacts of wood on wood or wood on metal. In construction all contact surfaces should be thoroughly impregnated with carbolineum and the less resistant timbers, such as apitong, montol, etc., should be painted over their entire surfaces. As many coats of carbolineum as the wood will absorb should be applied. Timber structures exposed to earth or water (for example, the backs of bulkheads, boats, etc.) should be coated with pitch. Special care is necessary in the selection of timber for use in salt water, since teredo is especially abundant in these waters.

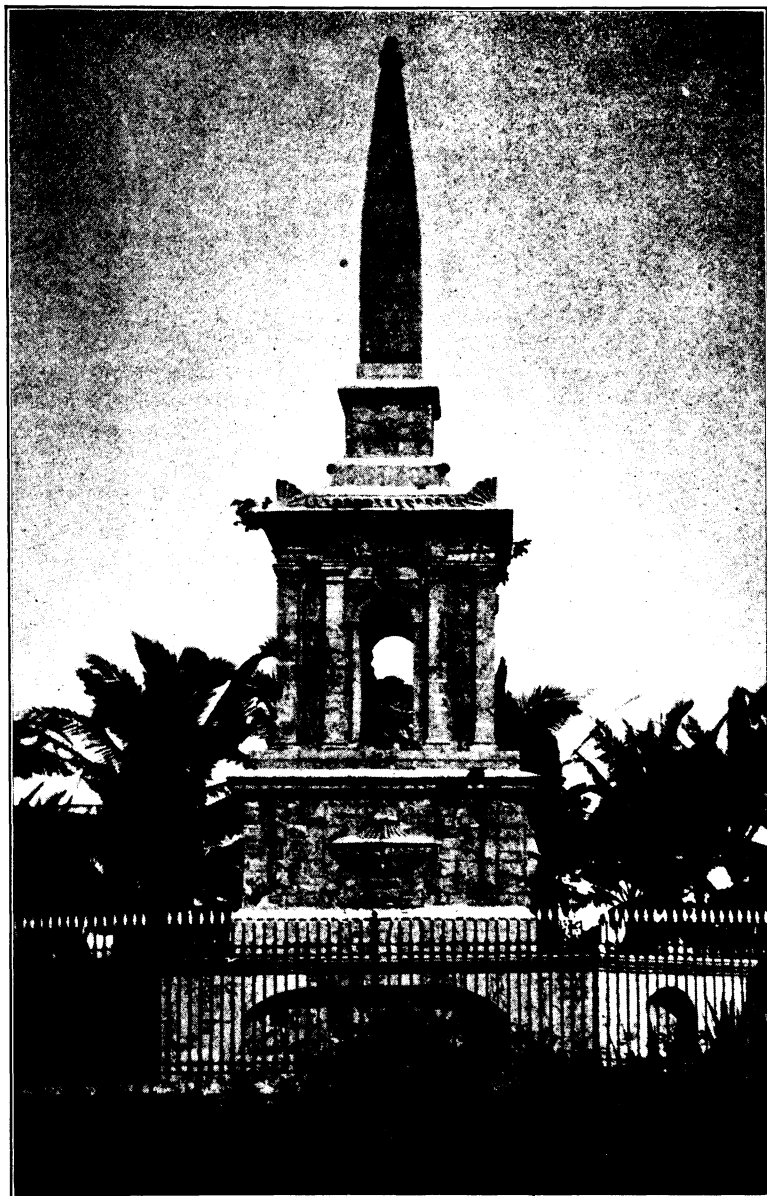
Throughout the foregoing article, the attempt has been to avoid questions of purely theoretical interest. The correct choice of paints and proper care in applying them has been emphasized as a practical problem, involving, in the Philippines, the conservation of an investment of several millions of pesos. Many of the statements will seem to technical readers self-evident and of elementary character, yet these very simple, important things are the ones most often neglected.

#### PUBLIC WORKS, PAST AND PRESENT IN CEBU PROVINCE.

By C. RUSSELL, District Engineer.

Public works in Cebu in Spanish times were largely under the control of the local officials, the Bureau of Public Works acting only upon request and then simply in an advisory capacity. Funds were not plentiful, the revenue coming almost entirely from the "prestacion personal" which was paid, by the majority, with fifteen days labor in lieu of real money. The supervision of all such labor, as well as the collection of the tax for public works, was in the hands of the presidente assisted by deputies, the result being subject to the inspection of the local priest. Schools, municipal buildings, roads, and bridges were generally built under the presidente's direction

by laborers who were working out their taxes. The work in the various municipalities was supervised in a general way by the provincial governor, who also audited the presidente's accounts. The provincial governor was assisted by one engineer who was supposed



Monument at the location of the skirmish where Magellan was killed.

to furnish all the technical advice necessary for any work that might be in progress. The engineer was appointed by the governor. Some projects, usually steel or masonry bridges, were constructed by contract and were financed by Insular funds. These jobs seem to have been actually under the direction of the Bureau of Public Works and are about the only projects on which real engineering ability was displayed.

While funds were scarce, labor, on account of Cebu's large population, was plentiful, and a very good system of roads might have been built had the labor been intelligently supervised and systematically applied. For example, 20 or 30 kilometers of road on the west coast must have been in excellent condition at one time, but was almost isolated from the rest of the provincial system by a few kilometers of heavy grades. These grades might have been avoided by a very little technical supervision during the location.

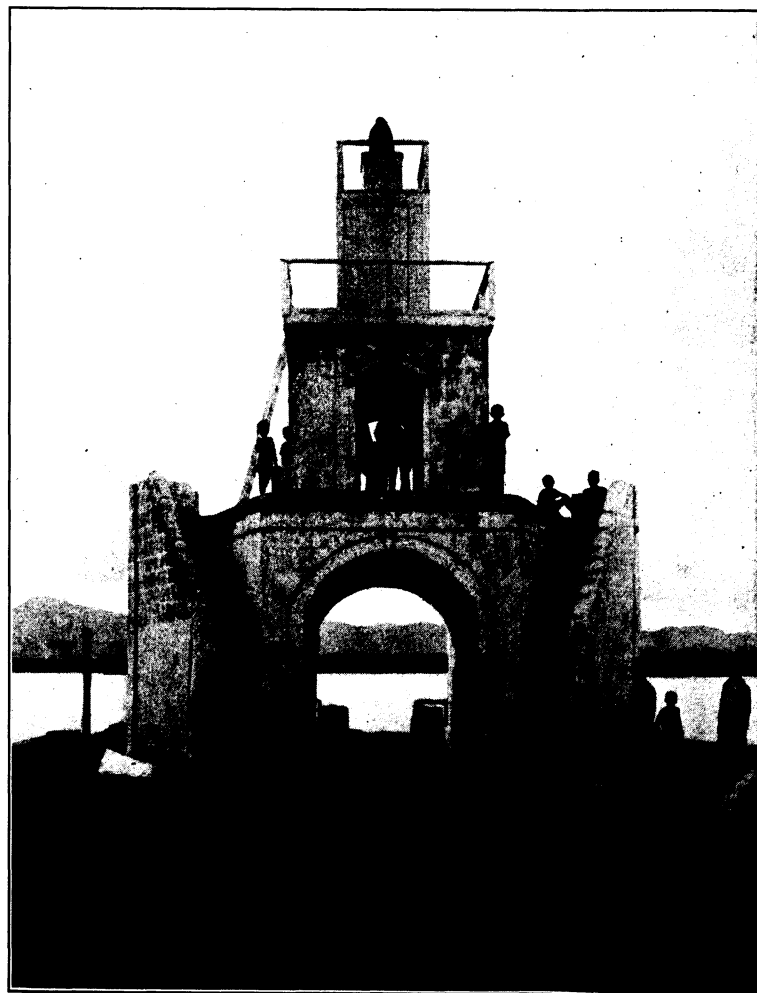
A résumé of public works and construction methods in Cebu during the Spanish administration discloses the following: A very good road existed between Carmen and Oslob on the east coast; a fair road from Pinamungahan to Asturias and from Barili to Samboan on the west coast. Another passable road led from Carcar across

the island to Barili, and there were also a number of short, inter-municipal roads, such as the one from Talisay to Pardo and the one from San Francisco to Tudea on Camote Island. It is estimated that about 290 kilometers of road were passable for vehicles, most of it ranking about third class according to our present standards, although considerable portions, especially in the poblacions, was of better grade. Generally speaking, where no location problems presented themselves and where construction could be carried on without explosives or road-building equipment, the results obtained by the Spaniards were fairly good, but under other conditions the opposite was often the case.

The following pages give an outline of the work accomplished since the American occupation together with that now under way:

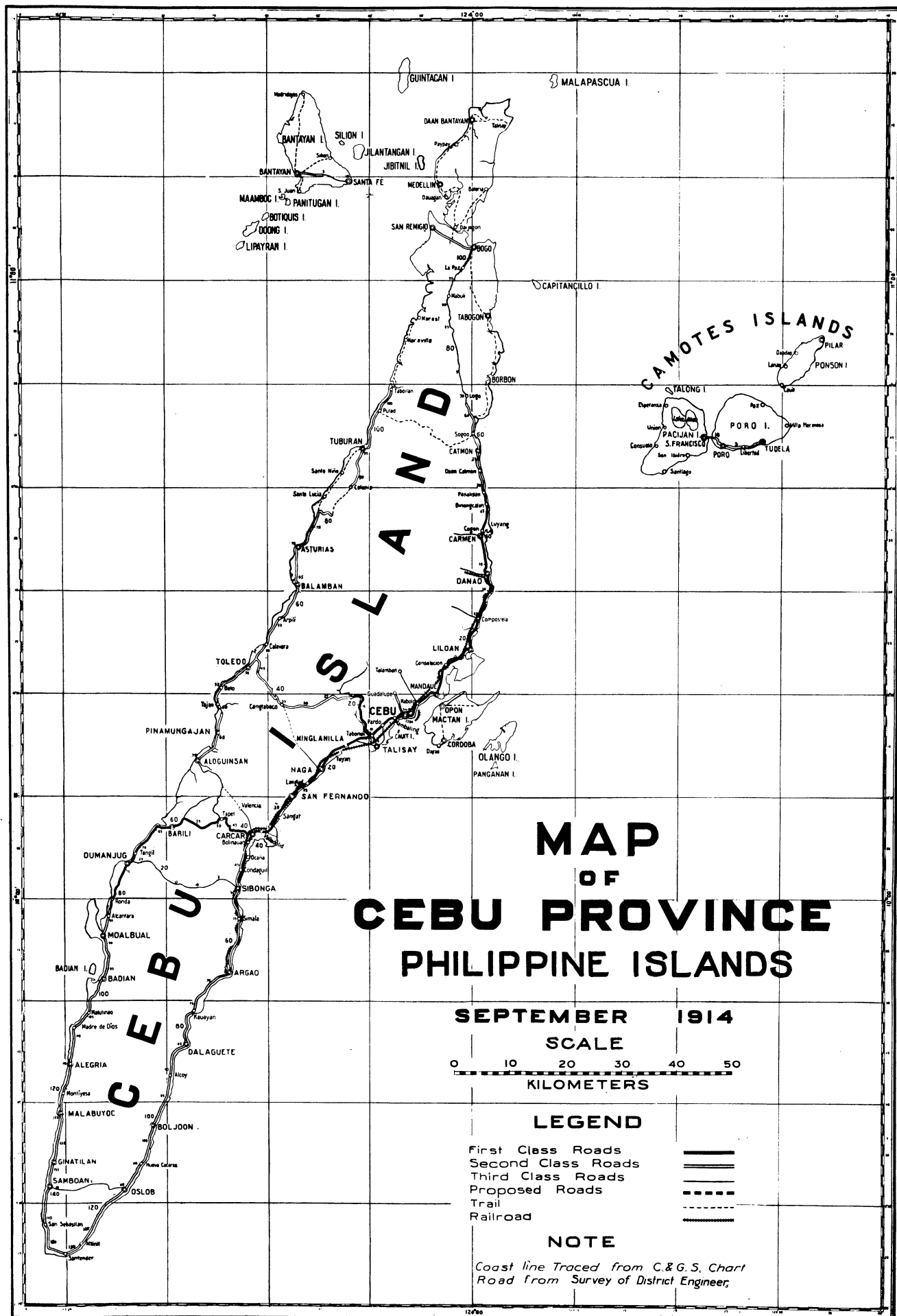
#### ROADS.

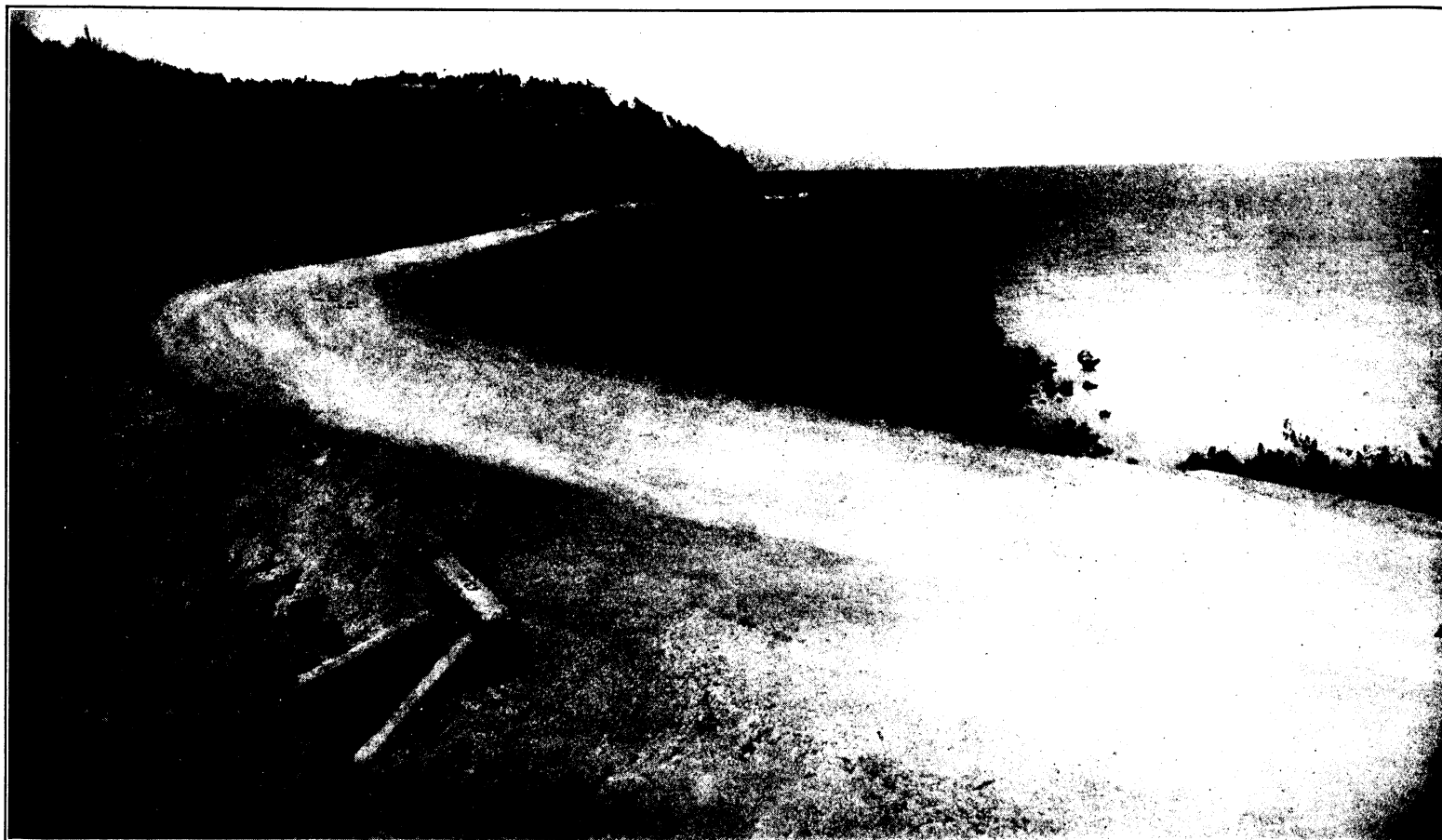
Every municipality in Cebu, and there are 46 of them at present, is located on the beach. Boats can load and unload at all towns and sea-coast barrios nearly every day in the year, so that water transportation—the cheapest transportation in the world for a long haul—has always been used in marketing the products of the province. Inasmuch as the population of these 46 towns at present totals about 800,000, there is considerable passenger travel between municipalities, together with the usual short-haul freight traffic that prevails when the produce is being taken from the farms and inland barrios to the local markets. To accommodate this traffic a road system has been developed that includes almost every one of the 46 towns. Leaving Cebu by auto it is possible to go south along the east coast through Carcar to kilometer 41 over a first-class road,



Osmeña gate, Opon, Mactan Island, Cebu Province.

then on a second-class road to the barrio of Santander (kilometer 133), at the extreme southern end of the province. At Boljoon, 102 kilometers south of Cebu, there is a short stretch of subgrade where in Spanish times an immense amount of labor must have been

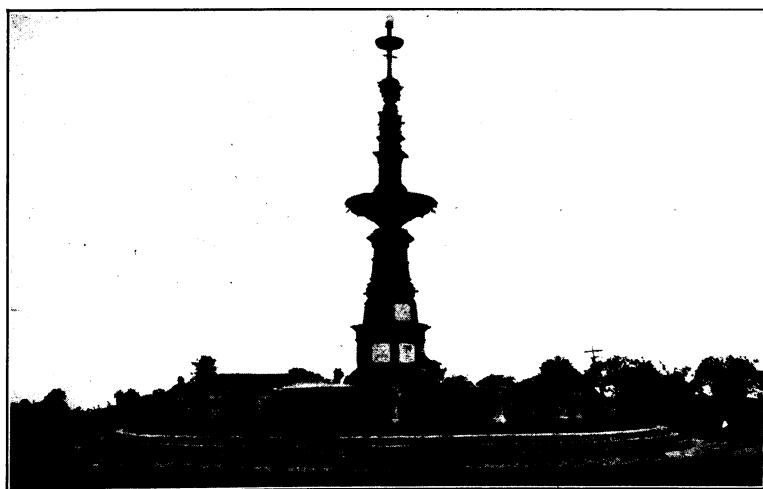




Kilometer 66, Carcar-Barili Road, Cebu, Cebu Province.

expended on construction. The location is in a side hill through soft coral limestone, and over 30,000 cubic meters of this material must have been moved in constructing one-half kilometer of road. At Oslob is found one of the largest of the old forts built as a defense against the Moro pirates of early times; it covers about  $1\frac{1}{2}$  hectares of ground and probably offered shelter to several thousand people. A hot-sulphur spring is found at the barrio of Mainit (kilometer

Road connecting the east coast with the towns of Pinamungahan, Toledo, Balamban, Asturias, and Taburan. This road rivals the Benguet Road for scenic effects. At one point a good baseball player can throw a rock into the river over 800 feet below the road bed, while at kilometer 31, on the north slope of Mount Uling, the whole west coast is visible, together with the island of Negros and the Canloan Volcano. The highest altitude on this road is 490 meters



Osmeña Spring Cogon, Cebu Province.



Carcar-South Road, Cebu, Cebu Province.

129), where the Spaniards had quite a health resort. From Santander the car can return via the west coast to Alcantara, passing over 70 kilometers more of second-class road, and then on first-class road to Carcar again and Cebu, making a total trip of 287 kilometers.

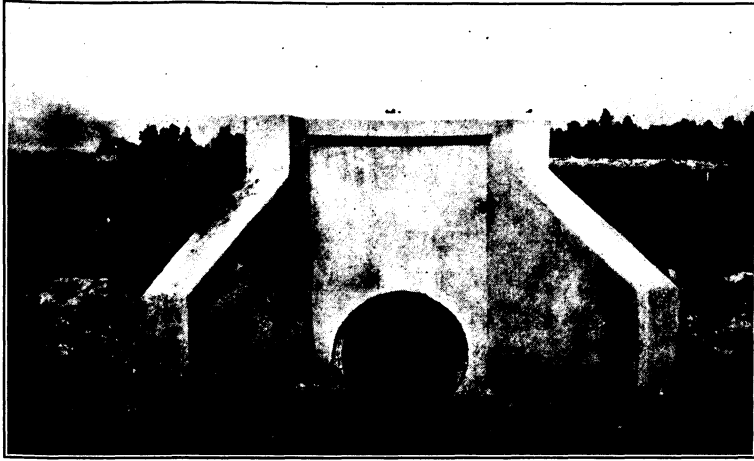
At kilometer 8 on the south road, the first-class road branches off to Talisay through some of the best sugar and rice land in the province. Further on, at kilometer 9, begins the famous Cebu-Toledo

at a distance of only 12 kilometers from the coast. The Cebu-Toledo Road connects with the West Coast Road at kilometer 47. From here it is possible to go north by auto through Balamban and Asturias to Taburan at kilometer 96, or south to the barrio of Tajao (kilometer 58).

The Cebu-North Road will eventually reach Bogó, a municipality at the north end of the island. The road is first class now to



kilometer 48 and second class to kilometer 68. Construction was also started from Bogó south, both the subgrade and surfacing being completed to kilometer 98 and the subgrade alone to kilometer 95, leaving an impassable section of 27 kilometers yet to be completed. The road



Class of concrete and cement culvert on the Barili-Ronda Road, Cebu Province.

follows a beach location from Cebu as far north as kilometer 62, part of the way being over causeways through nipa and mangrove swamps where the water at high tide is 3 or 4 meters deep on both sides of the right of way. At kilometer 62 the location leaves the coast and follows a valley to the interior of the island at kilometer 70, and from there it runs through rice and only partially developed agricultural land to Bogó.

A projected road from Pinamungahan south connecting the Carcar-Barili Road at kilometer 51 will open the west coast north of Barili to auto-truck traffic. Passenger trucks are now operating out of Carcar to Dumanjug south to Barili, and the same sort of service will begin when the road is finished north. This road will also lead through a most excellent agricultural region and will do much toward assisting the traffic development of the Philippine Railway from Carcar and north.

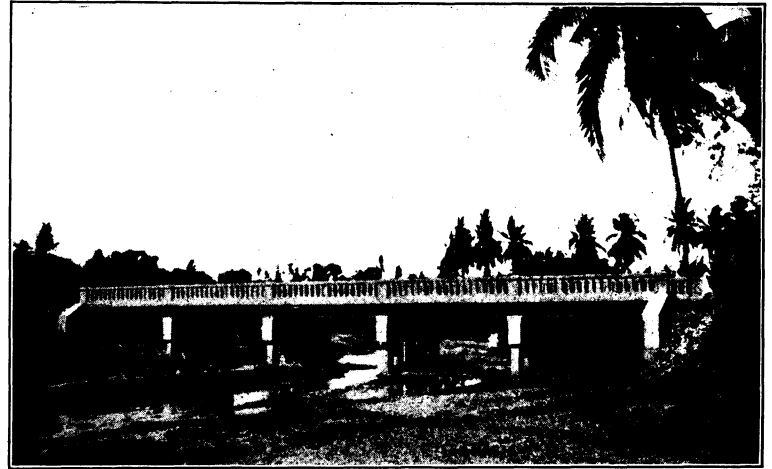
It is well to offer here a short description of the Danao Quarry, the methods used in its operation, and the way the finished product—road metaling—is distributed over the province. When first-class road construction was started in Cebu the only material available for surfacing was river gravel, except in a few localities. This metaling required constant replacing, and ran the cost of maintenance



Kilometer 71, Barili-South Road, Cebu Province.

up to a figure considerably above normal. It became evident that a quarry must be opened and the Danao site was selected. A siding was put in by the Philippine Railway Company so that rock drops from the screens directly into the cars. The level of the track is

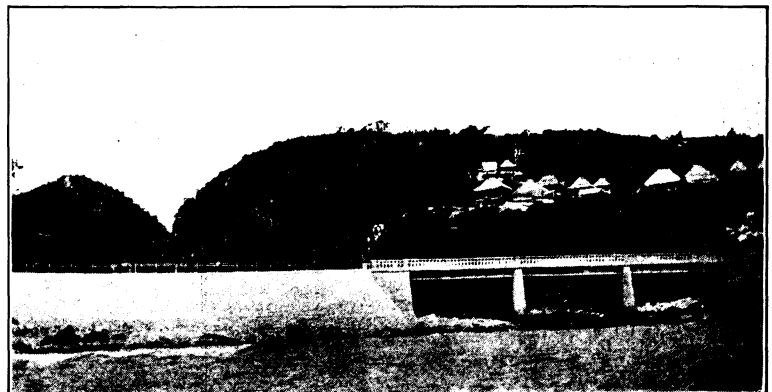
about 4 meters below the level of the crusher platform and the level of the tramway leading from the quarry is 3 meters above the same platform. The tramway is laid with a slight descending grade so that the loaded cars will run by gravity from the quarry to the track above the crusher platform, where they are dumped and the rock fed into the machine as usual. The crushed material coming out of the screen is carried by chutes to the railway cars on the track below, separate chutes taking the screenings, the first and the second course rock. The rock quarried and ready to feed into the crusher is purchased from the laborers at a certain price per yard,



The prize bridge spanning the Danao River, Cebu Province.

payment being made before the unloaded tram car is pushed off the track above the platform. In getting the rock out in the quarry the small pieces, overlooked by the men, are picked up by the women and children and sold at the crusher, the measuring unit in this instance being the wooden coal-oil case.

Inasmuch as considerable difficulty has always been encountered by the Government in making small payments promptly to a great number of individuals for materials furnished, it has proved more satisfactory to let the operation of the crusher by contract, the province paying a certain amount per cubic meter for the finished product on board the railway cars. The first-class road from Danao to Carcar, a distance of 71 kilometers, lies parallel to the Philippine



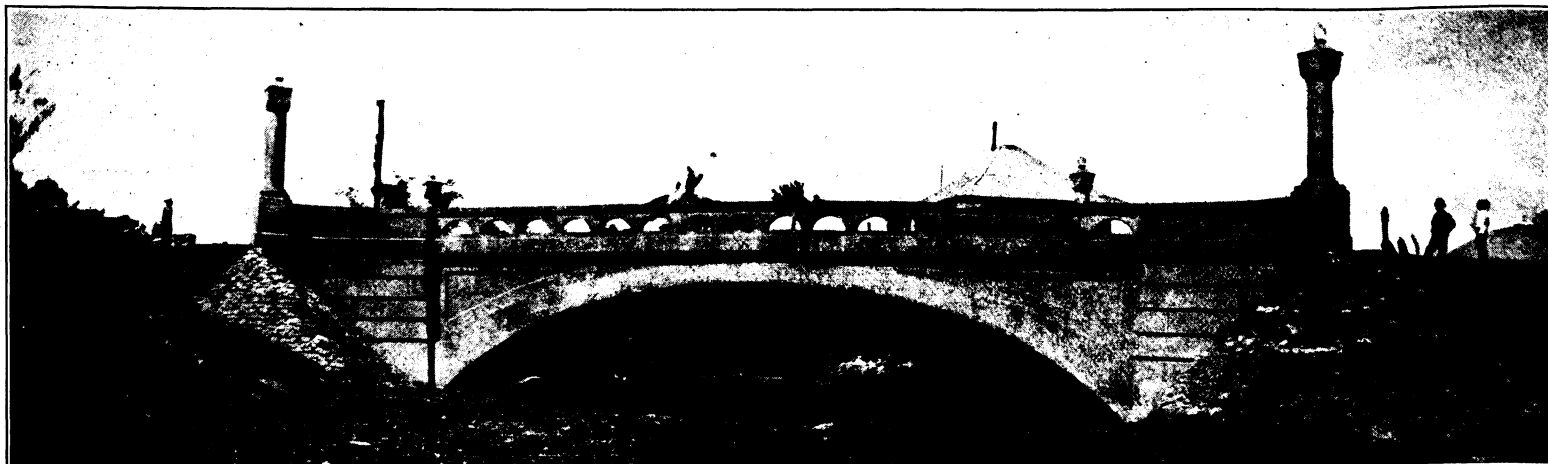
A bridge partially erected from road prize money, the Macumbucine River Bridge, Cebu Province.

Railway Company's tracks, hence it has been a very easy matter to discharge the crushed rock and haul it by hand carts to the places where it is needed.

#### BRIDGES.

Several large modern steel bridges were constructed in Spanish times throughout the province. Two lattice girder bridges of 19.95 meters span each, built about 1895 on the Cebu-South Road are in excellent condition, as is a 20-meter through truss at Dumanjug on the west coast. A deck truss, span 39 meters, of very light construc-





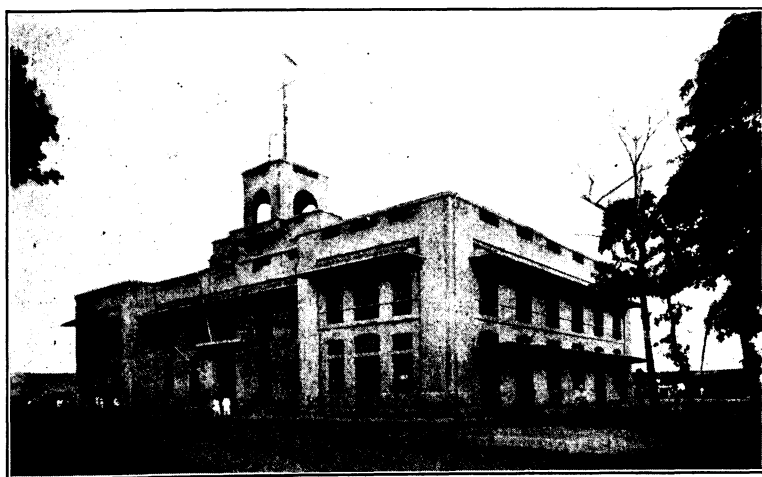
Forbes Bridge, Cebu, Cebu Province.

tion on a screw pile substructure, crosses the Simala River at kilometer 54, south of Sibonga. This bridge is in good condition, but is hardly strong enough to carry a 12-ton roller, although it is often used by motor trucks. The Butuanon Bridge at kilometer 8, north of Cebu, was a most excellent 20-meter deck truss, but came to grief in the typhoon of 1912, due to a substructure failure. It has been rebuilt with one approach span and now gives good service. A number of small steel bridges, as well as masonry arches too numerous to mention, are a heritage from Spanish times and, after a little reconstruction, they are fulfilling all present needs.

Most of the common types of modern bridges have been built in Cebu. The Forbes Bridge is a good example of the ornamental concrete arch. It crosses the Guadalupe River at Calle Magallanes and connects the población of Cebu City with the large barrio of San Nicolas. The arch has a span of 20 meters and a clear width of roadway of 9 meters, with two sidewalks of 2 meters each. The Dalaguete Bridge over the Tapon River at kilometer 84, on the Cebu-South Road, is the largest of the arch type in the province. It consists of two 19.81-meter spans, each having a rise of 4.95 meters above the springing line. There are several other arches and a number of through trusses, two of these being of 100-foot span and one 60-foot span, a good many bridges of the slab and girder type, both on concrete piles and on massive concrete substructures, and a collapsible bridge with a floating deck on pile bents, the latter having just been completed. Altogether in Cebu Province there are 52 permanent bridges and 451 culverts with a total span of 1,403.84 meters.

is the first thing that draws the attention of the visitor arriving in the harbor. The main building is of three stories, with a central tower rising two stories higher. The type of construction is of the plainest, although the final result achieved by the architect's use of tile and concrete is very pleasing to the eye. The Southern Islands Hospital is a small though modern building situated in the Government Center now being developed in Cebu City. It is of reinforced concrete with a flat tile roof on steel trusses and is surrounded by spacious grounds. The Provincial High and Trade Schools are housed in a group of four buildings that do credit to the province. Part of the school group is a well-equipped athletic field with a quarter-mile running track and a 220-yard straightaway, a baseball field, and courts for tennis and basket ball. The records of Cebu High School athletic teams in the past go to show the good use to which the field has been put. The Constabulary barracks and officers' quarters and the 20-room intermediate school now under construction are worthy of mention, as well as the old provincial and municipal government buildings and the city market, the two government buildings being of Spanish construction.

Scattered over the province outside of Cebu City are 20 modern school buildings constructed as is usual with two-thirds Insular fund appropriated under the Gabaldon Act. These schools contain 86 rooms in all, and have a seating capacity of 3,440. They vary in size from the Consolacion building, a one-room standard, to the Argao and Dalaguete buildings, both No. 10 plans. The total value of these buildings is over ₱210,000.



Cebu customhouse, Cebu Province.

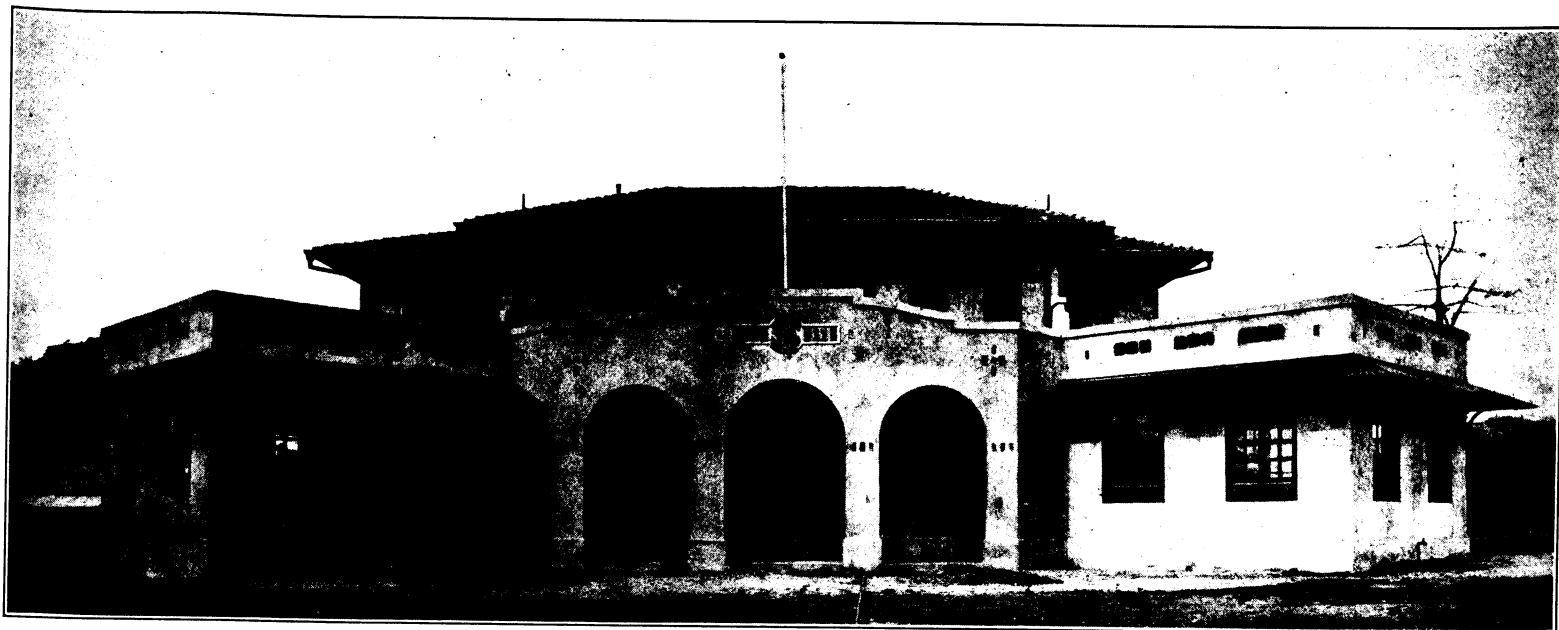
## PUBLIC BUILDINGS.

The most notable public building in Cebu is the new customhouse, completed in 1912 under the direction of the Consulting Architect. This edifice is located in a prominent position on the waterfront and



Constabulary barracks, Cebu, Cebu Province.

The market construction program here has been rather extensive. An attempt has been made to establish a chain of weekly markets in the principal towns in the southern part of the island. There are six adjacent first-class municipalities here, namely, Dumanjug and Barili on the west coast and Carcar, Sibonga, Argao, and Dalaguete on the east coast. The idea is to establish a large market in each town on certain days of the week, arranging the dates so that



Southern Islands Hospital, Cebu, Cebu Province.

the traveling peddlers can start, for instance, on Thursday in Dalaguete and be sure of a big market crowd, then go on to Argao for Friday market, Sibonga on Saturday, Carcar on Sunday, etc. With

this end in view, all the above-named towns, excepting Sibonga, obtained loans for the purpose of constructing modern market buildings. The work was begun at Carcar by the district engineer on November 8, 1912, and the last building was completed at Barili on June 30, 1914. In addition to these buildings a modern market was constructed at Opon on the island of Mactan and one at Oslob near the southern end of Cebu.



Osmeña Waterworks, Cebu water supply, Cebu, Cebu Province.



Spillway of Osmeña Waterworks dam, Cebu, Cebu Province.

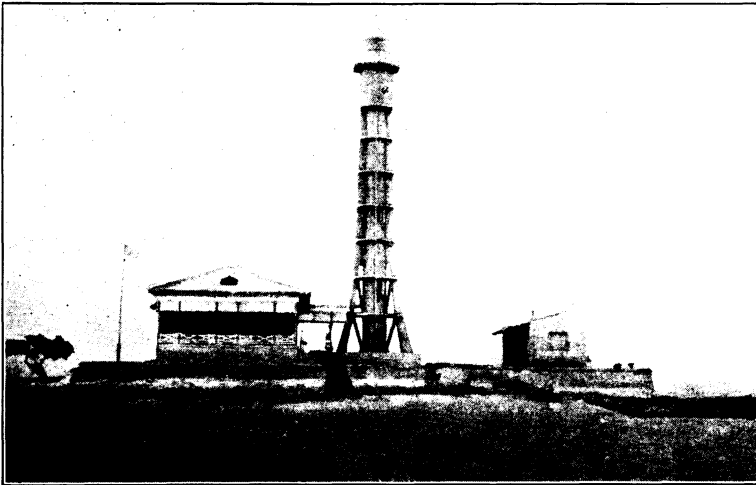
## WATER SUPPLY.

The Osmeña waterworks system, the important water-supply project in Cebu, has been written up on previous occasions, so only a short general description, quoted from a previous issue of the *QUARTERLY BULLETIN*, follows:

The Osmeña waterworks system supplying the city of Cebu with water was completed early in 1912. The main features of this project are an arch spillway dam located in a narrow gorge 7 kilometers west of Cebu, a large concrete distribution tank near the town, and the distribution system in Cebu itself. The project was financed by a gift from the Province of Cebu of ₱50,000 and a loan from the Insular Government of ₱500,000. Great benefits have already accrued to the city of Cebu from this undertaking.

The work has been justified in every way; the general health of the community has been improved; fire risks have been greatly lessened; and financially the city has shown its ability to meet all payments of principal and interest on the borrowed money.

A small gravity water-supply system has been built in San Francisco on the Camote Islands. A galvanized-iron pipe line brings the water from a spring to the storage tank, a distance of 2,300 meters, and then distributes it throughout the poblacion. Before the construction of the system all drinking water had to be carried from the same spring.



Capitancillo light station, Cebu Province.

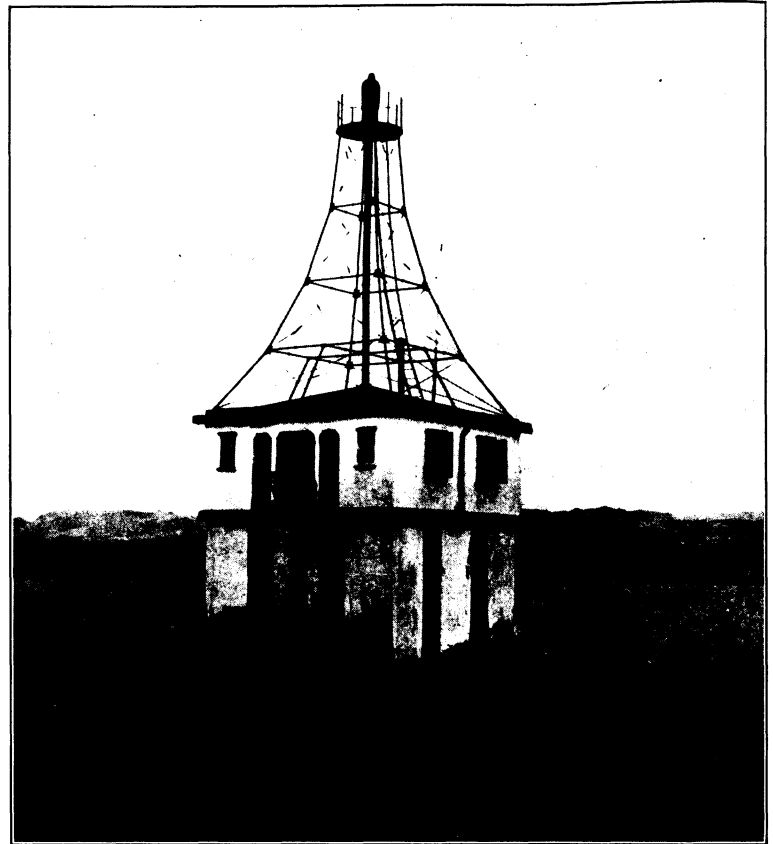
Drilling for artesian wells has not been very successful in Cebu, the only flowing well having been completed in Argao. This well flows only at high tide, the water falling below the level of the outlet when the tide is out. A very good pump furnishes water during such times. Two pumping wells have been completed in Dalaguete and very good success is anticipated in Toledo, where a deep-well rig is now operating.

## HARBOR IMPROVEMENTS.

Cebu City has always been famous for her good harbor. When Magellan landed at Cebu in 1521 he learned that the Chinese had been in the habit of making calls for trading purposes in Cebu for hundreds of years before his arrival. The port, until recently, had almost no landing facilities, all cargo being transferred from the steamer to the beach in lighters. Work was started in 1905 on a modern sea wall and now there are 905.41 meter of wharf, equipped with cargo-handling cranes and traversed by a double-track railroad that connects direct with the Philippine Railway Company's tracks. Ships drawing 30 feet of water can be berthed alongside the wharf without any danger of grounding even at extreme low tide. The seawall, completed in 1908, is of the massive type of concrete construction. The surface or steel level is 10 feet above mean lower low water, and the base, resting on a pile foundation, is 25 feet below the same datum. The new wharf was completed, as far as the concrete work is concerned, in 1913, but it could not be used until recently on account of the lack of road material on the deck. The work of surfacing is now in progress, using stone from the Danao Quarry with an asphalt binder.

## GENERAL.

The most important of the public improvements of a general nature is the work of the Cebu burned area committee. In 1903 a disastrous fire destroyed most of the business district of Cebu, which, as is



Laus Ledge, Cebu Harbor, Cebu Province.

common with almost all old Spanish towns, had been constructed with narrow, crooked streets, very poorly drained, and laid out with no regard for direction. A law was passed (Act 1614), creating the Cebu burned area and placing all property within its limits under the control of a committee consisting of the provincial governor as chairman, with the Director of Public Works, the municipal presidente, the municipal treasurer, and the district engineer as members.



Calle Colon, Cebu, oldest street in the Philippine Islands.

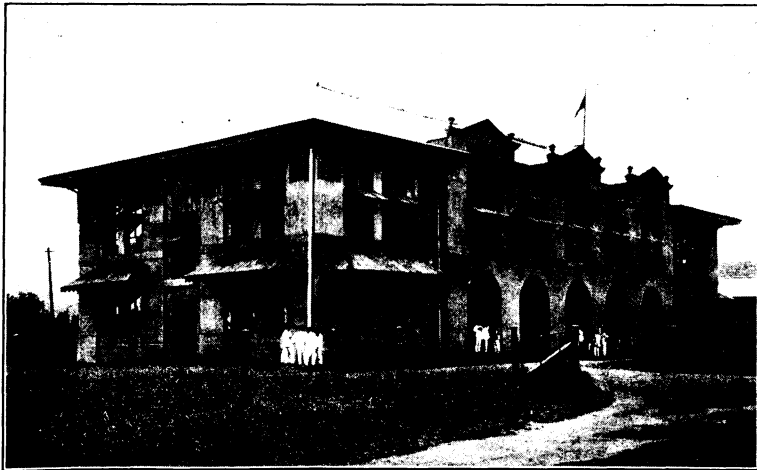
This committee laid out a modern system of wide streets without regard for the old narrow ones, put in curbs, gutters, catch basins, and some storm sewers, and did all that was possible with the funds available to make Cebu's business district like that of an up-to-date American or European city. The land that had been in the hands

of the committee was then returned to the original owners, less the property expropriation for the new streets. The results are illustrated by a comparison of the pictures entitled "The oldest street in the Philippine Islands" with the view of Calle Magallanes.



Calle Magallanes, one of the new streets in Cebu.

Public improvements that may be realized in the future are numerous, and the lack of funds is all that stands in the way of their completion. Some worthy of mention are: The gravity water-supply systems for the towns of Pilar, Catmon, Naga, Carcar, Argao, Samboan, Moalbual, Barili, Tudela, Poro, Malabuyoc, and Ginatilan; a hydroelectric light plant, sanitarium, and public bath at Barili; municipal buildings too numerous to mention; a system of sanitary sewers for Cebu City and a ₱250,000 provincial government building at the proposed government center. Great strides have been made in the



Cebu High School, Cebu Province.

improvements of plazas and public parks and still greater progress will result in the future. Many market buildings are to be built, schools are needed, additional roads and bridges are still required; in short, while the work already accomplished is extensive, a great amount still remains for the future supervision of the Bureau of Public Works.

## GRADE AND ALIGNMENT.

By W. H. WAUGH,

Member of American Society of Civil Engineers.

Lacking instructions to the contrary, the locating engineer should assume that his duty is to find the best line or that line which for a term of years will best fulfill the requirements of traffic for the least cost. The least cost includes subsequent maintenance as well as the first construction cost.

Funds may be so limited that the locating engineer may be compelled to adopt a cheaper line in place of the best line. This does not mean that the so-called best line is to be wholly abandoned. It means rather that the best line is to be used as far as practicable. This can be done by building the cheaper portions of the best line at the start, only making occasional diversions and introducing heavier grades at the most expensive points to avoid a cost beyond available funds.

In locating a highway it is always well to remember that the location will very likely serve for generations and possibly for all time, as the growing importance of the surrounding country and location of property lines, buildings, etc., will make it difficult as well as highly expensive to change a highway after it has become well established.

In many sections roads or trails have been in use to a greater or less extent for many years. Rights of way have been marked and the location for an improved road is more or less restricted. In such cases the location consists principally of a relocation of certain stretches. The original location may have been entirely satisfactory at the time the first road was put through when scientific engineering and existing practice was unknown. Such locations must be improved to meet modern requirements. In a relocation over old or abandoned roads for the construction of an improved highway the grade, alignment and other features should receive as careful study as an entirely new project.

There are many old Spanish roads in the Philippine Islands, which, under the conditions governing at the time they were built, were well located, and in some instances, with a high degree of skill. Such locations would be harshly judged if made to-day and compared with existing standards. The early road builders cared little for the amount of labor necessary to construct a project. They simply impressed or secured for an insignificant wage as many men as they required and pushed it through. On the other hand, they were extremely careful how they incurred expenses for material. This undoubtedly accounts for the general aversion to side-hill locations and for the care exercised to avoid as much bridge work as possible.

Under American occupation these conditions have undergone a decided change. The road laborer is now paid a fairly high daily wage, and cement, steel, and other materials are used wherever necessary.

During the period when there was considerable military activity in most of the provinces, roads were built not as permanent highways, but for the purpose of forwarding supplies or troops in the quickest time for the least first construction cost. These roads may have been constructed for use for a few days only, to keep up communication between camps, or for an indefinite time. Some of such roads have been improved more or less and now form important sections of the highway systems; others have been abandoned.

It is over these old Spanish and American military roads that most of the relocation work will occur. The locating engineer should keep in mind the values applied to rate of grade and alignment by the men who built the early roads, and their traffic requirements. At the same time he should not forget that he is living in a different age and that means and methods are advancing as well as the time.

The Atimonan-Pagbilao Road was first built for a pack trail pure and simple. It is no discredit to the engineer who located this trail that the country quickly and greatly developed and that now this former pack trail is a part of the main Manila-South automobile road and is gaining in importance every day. The engineer who located the line did a good piece of work and it was well adapted to its original use. We should, therefore, consider the purpose and difficulties of such pioneers before making too many hasty criticisms.

It is often truly said that the best place to find fault with a railway location is the rear end of a private car (carefully provided with the necessary impedimenta, etc.). However, such inspections happen long after the locating engineers have been dangling over cliffs on the end of a rope in spiderlike attitudes, or a party has pushed on in some other equally uncomfortable manner incident to getting a line through. The country has a right to different appearance after the work is finished and is then very easy to point out the defects.

At the present time we cannot offer many of the excuses of the

Spanish and military pioneers. On all important roads we must now provide accommodations for heavy freight to be hauled by motors. The most direct alignment and lowest grades must be sought, or we will justly come in for our full share of adverse criticism by our successors.

On relocations it has often happened that opportunities for improvement in grade and alignment have been overlooked. Occasionally a swing of a meter or so at either or both ends of a generally direct course will give a truly straight line, and avoid one or more bad kinks that a mere road laborer would not bother with or know how to remedy. A trifling expense for a little extra right of way here and there, moving an occasional nipa shack or running through a few clumps of bamboo to get a better line or grade will often prove whether or not the locating engineer is the kind of a man he should be. On a great many old roads much straightening out, both vertical and horizontal, can be accomplished without greatly increasing the cost and no opportunity should be overlooked to secure the best line available for the money.

It is necessary to remember that a location which is generally good, and where the heavy grades and sharp curves are the exception, can be improved later on for a reasonable cost. A bad location is hopeless and later improvement will practically amount to constructing an entirely new line. The practice of laying out curves with a 20, 30, or 40-meter tangent distance as a general plan is not related in any way even to amateur engineering. Such curves have been put in time and time again with no attention being paid to the amount of central angle, topography, or any other of the usual factors. The only excuse which can be offered for such practice is that it is easy to do and the survey men are familiar with such a layout. Where curves are necessary, remember that, other considerations being equal, the longer the radius the easier the curve and also the shorter the distance to travel.

It has often been stated that grades and curves on roads are not the important factors they are on railway work, providing certain limits are not exceeded. It is true that those refinements required on railroad locations in the way of grades and alignment are not as necessary when dealing with highways. However, grades and curves should be as easy as funds and the country will permit. The writer noticed a paragraph a short time ago which said "grades in excess of 5 per cent should be used with caution." This would have been stated better had it read "all grades must be used with caution." Never put in a 2 per cent where a 1.2 can be had for the same money and will fit the case better. Short and sharp adverse grades should be avoided as much as possible. Any adverse grade is bad enough. Frequent breaking of the grade line may be necessary, but care must be taken to see if a longer uniform grade would not do better. A satisfactory or workmanlike product does not result when a hit or miss plan is followed.

Every grade and each curve should be backed up by a sound engineering reason for its adoption. When a project is finished, make it apparent to the traveling public that it was built by an engineer and that the amount paid for professional services was a profitable investment.

## MUNICIPAL WATER SUPPLY DATA.

By G. G. STROEBE,

Hydraulic Engineer, Bureau of Public Works.

For some years there has been a growing interest in the matter of municipal water supply in the Islands. This fact is attested by the popularity of the systems now in use, as well as by the large number of requests from municipalities for the installation of piping systems to supply water to houses and to convenient locations in town for general domestic supply and fire protection. Conditions peculiar to the locality present themselves in each individual instance, requiring special treatment in design. One town may have the simplest case of an abundant supply from a nearby spring at sufficient elevation to supply, without storage, water at suitable pressure for all purposes. In other instances conditions may be found slightly complicated, as

in the case of San Pablo, Laguna, where the source of supply is located at some distance from town and at an elevation requiring a fairly large pipe line to carry sufficient water for all purposes, and a standpipe to regulate the pressure when fire protection is required. Then there are such cases as Vigan with its problem of high pressures on a long main pipe line; Cebu, with its high storage dam and pressure regulating reservoir; Iloilo, with its alternative of an expensive pipe line system to be operated by gravity from a distant river, or an artesian well supply necessitating pumping, both problems being complicated with fire protection requirements; and Taal, with its problem of pumping from springs or deep artesian wells to elevations, which, for the sake of economy, it is necessary to divide into zones.

Instances like the foregoing could be multiplied, each possessing its own peculiarities. In the midst of problems requiring such diversity of solution, it is felt that an effort should be made to set forth the proper procedure in the investigation of such projects, and to systematize, as much as possible, the data necessary for a correct design. To that end the following outline has been prepared. Necessarily this outline is somewhat general; some references in it will be obviously inapplicable to certain individual cases; and there may be instances where data should be presented on matters which are not included in the list. In the main, however, it is hoped that the list may be found inclusive enough of principal details, and suggestive enough of other matters which it may be considered necessary to present in individual cases, that the outline will prove helpful in the making of future investigations of proposed water supplies, and in systematizing the data therefor.

The method of procedure as outlined below is practically the same as has been followed in acquiring data for the design of some of the more costly systems in the Islands and has been productive of very good results here. It is also consistent with the practice of many large engineering establishments in the States engaged in development work on a large scale. Briefly the method suggested is as follows:

(1) A preliminary examination of the proposed project by the district engineer, in which all data is secured economically, yet with sufficient accuracy, so that a reasonably close estimate can be made of the cost of the project and an intelligent opinion rendered as to the advisability of developing the same.

(2) A final examination by the designer and the district engineer, if it is found after the preliminary investigation that conditions warrant developing the project. The designer should personally determine on the ground the principal hydraulic features involved. He should also confer with the district engineer, outlining to him what further data should be furnished to enable the designer to complete the final working plans.

(3) A final report by the district engineer after all necessary information has been secured, made up in convenient workable form, including all maps, profiles, estimates and other data pertaining to the project, to form a basis for the complete design of the system.

This method of procedure is in general the most economical, even though it involves at least two examinations on the ground if the system is to be constructed. To render a report at the start which is, in every case, sufficiently complete and accurate to form the basis of the design would often involve a useless loss of time, money, and effort on the part of district engineers, who already have their time fully occupied with necessary work. There are many visionary projects that are worthy of only cursory examination. And there are many which after the first investigation are found to be nonfeasible. Incidentally, mention should be made here of that class of projects which, although not feasible at the time investigated, have such good prospects of ultimate development that the expense of complete final examination is warranted; and a final investigation may be requested with this object in view.

The above procedure is recommended for the more expensive projects—those costing, say, ₱50,000 and upwards. There are many projects which are so small that the expense of an investigation by an engineer from Manila is not warranted; there are others which are so apparently feasible and necessary, and the method of development of which is so evident, that the preliminary examination might

be dispensed with and a complete final report thereof made at the start. Necessarily the district engineer must use considerable discretion in these matters that the work may be expedited and results accomplished most efficiently.

The outline for the submission of data is presented below. This outline is divided into three parts: (a) The part devoted to matters to be considered in a preliminary report [printed in common type]; (b) the part given to matters requiring attention in a final report [printed in italics]; and (c) the part indicating problems to be solved by the designer [printed in small type]. It may be remarked that part (c) is included in this outline because, in some cases, the district engineer may make the designs as well as the final report for the system.

#### OUTLINE.

(Parts in common type indicate matters to be considered in the district engineer's preliminary report.)

(Parts in *italics* indicate matters to be considered in the district engineer's final report.)

(Parts in small type indicate matters for the designer's consideration.)

#### LOCATION:

1. Name of municipality.
2. Province.

#### POPULATION:

3. Total population of municipality.
4. Population to be served by the proposed system.
5. What is the probable increase in population to be supplied during the next fifteen years?

#### PRESENT WATER SUPPLY:

6. What are the present facilities for obtaining water in the municipality—
  - (a) Of the population which the proposed system will supply?
  - (b) Of the remainder of the population?
7. State if data are available—
  - (a) Quality of the water used.
  - (b) Estimated quantity (1) used, (2) sold.
  - (c) Method by which water is distributed.
  - (d) Average distance water is carried.
  - (e) Price paid, if water is sold.

#### PROPOSED WATER SUPPLY:

8. (a) Character of the source (spring, stream, filter beds, artesian wells, etc.).
- (b) Send, if available, photographs showing spring, location of intake, etc.
9. Quality of the water (from Bureau of Science analysis).
10. Minimum flow—
  - (a) Quantity.
  - (b) When and how measured? If with a weir, describe same (See description of weirs hereinafter.)
  - (c) Submit observed data and show how quantity was calculated.
  - (d) What is the length of time that low water flow continues?
  - (e) At minimum flow, what is the supply in gallons per day per capita of population to be served?
11. Maximum flow—
  - (a) Quantity.
  - (b) When and how measured? If with weir, describe the same.
  - (c) Submit observed data and show how quantity was calculated.
  - (d) What is the length of time that high water flow continues?

#### 12. Watershed area—

- (a) *What habitations or other sources of possible water pollution does the watershed contain?*
- (b) *Will it need to be reserved?*
- (c) *Estimated cost thereof; assessed value thereof.*
- (d) *Area of watershed. (The area in some cases may be estimated from maps. Watersheds that have*

#### PROPOSED WATER SUPPLY—continued.

#### 12. Watershed area—Continued.

*to be purchased or reserved from entry must be surveyed in accordance with the requirements of the Bureau of Lands for making such surveys.)*

- (e) *If a dam is necessary, give data if possible, which will show the maximum runoff from the watershed in cubic meters per square kilometer per second. (It is usually very difficult, if not impossible, to secure records of accurate information of this sort, as such information necessarily depends upon a series of measurements made during extreme floods. But the maximum discharge can often be estimated fairly well by other means, such as the rainfall records of the locality, and the known discharge of a somewhat similar area nearby.)*

#### 13. Regarding artesian wells—

- (a) If the proposed source of supply is an existing well, state specifically in addition to the general information asked for in sections 9, 10 and 11 (as far as these sections apply—
  - (1) Size and depth of each well.
  - (2) To what extent the elevation of the water in the wells was lowered by pumping at the time of the pumping tests; duration of these tests; discharge of the wells per minute during these tests.
  - (3) Elevation at which water normally stands in the well, if it is nonflowing.
  - (4) Cost of the well.
- (b) If the proposed source of supply is to be a new artesian well, then in addition to the information asked for above, give location with reference to the new well of all successful and unsuccessful wells that have been drilled in the locality.

#### KIND OF SYSTEM:

14. Is the proposed system to be a gravity or pumping project?
15. If a pumping plant is necessary, what kind of power do you recommend for use?
  - (a) If fuel is to be used, give unit cost of kind recommended.
  - (b) If electric power is available, state price.
  - (c) If an hydroelectric development is available for power, and if conditions warrant its development for the proposed pumping project, give full particulars regarding flow of river, reservoir requirements and possibilities, dam locations, etc. (See also herein sections 20, 21, 22, 53.)
16. Could an hydraulic ram be employed? If so, state—
  - (a) Flow of water available for drive pipe.
  - (b) Fall in meters in drive pipe.
  - (c) Distance in which this fall is obtained.
  - (d) Distance water is to be delivered through delivery pipe.
  - (e) Height above ram water is to be raised.
  - (f) If a double acting ram is required, give complete data on the stream furnishing the power as well as on the spring or stream furnishing the water to be supplied to the town.

#### HEADWORKS:

17. If the source of supply is a spring or small stream, what sort of an intake do you recommend?
18. What is your estimate of cost of a suitable intake?
19. *Give the principal dimensions.*
20. What building materials are available? Unit cost?
21. *Regarding foundations for dam, power house, and other structures—*
  - (a) *If piles are necessary, give cost of piles at the site; kind of piles.*
  - (b) *Give results of test borings.*
  - (c) *What is the distance to the nearest adequate rock supply? kind of rock? cost of rock at the site? cost of concrete materials delivered at the site?*



## HEADWORKS—continued.

22. *In case a dam is necessary, give complete topographic map showing entire area which would be affected by backwater from the dam and from overflow of river in times of flood. Show grade of river for several kilometers above and below dam and several cross sections of the river in this stretch, one cross section being at the proposed dam site. Show low water and high water on profiles.*

## MAIN PIPE LINE:

23. *Submit a profile of the most feasible route for the pipe line from the source or sources of supply to town, showing carefully all stream crossings, ravines, and summits. In locating the main pipe line it is desirable to avoid summits and depressions in the line, since at these places respectively air and heavy materials tend to accumulate, necessitating the installation of air valves and blow-offs. If possible, avoid sudden changes of grade in laying out the main pipe line. Careful note should be made of all difficulties in crossing ravines and streams, and, if necessary, a plan for meeting these conditions should be submitted. If decision on the matter of the most feasible route is uncertain, submit profiles of other feasible routes pointing out the advantages of each.*
24. *In case the country is rough submit a topographical map showing one or two meter contours with two or more desirable routes for the main pipe line.*
25. *What material will be encountered in excavating for the main pipe line and what is your estimate of the cost per cubic meter of excavation and backfill for a trench 50 centimeters wide and 80 centimeters deep? Will the excavation be wet or dry? Verify classification of materials by borings or test pits.*
26. *It is important to secure a location for the main pipe line such that every part on the line lies below the hydraulic gradient. If such a line would involve extra cost, give data needed for a comparison of its cost with the cheaper line.*

## RESERVOIR:

27. *Is there a site for a reservoir near the town between the town and the source of supply, or in any direction from town within reasonable distance, which will give a pressure of 40 lbs per square inch in town? One that will give 70 lbs per square inch? If so, show on the profile and map submitted with the report the location of the proposed reservoir. In a preliminary report give slope of ground at reservoir site.*
28. *What do you recommend for the capacity of the reservoir, making allowance for pump repairs, minimum flow at source and maximum flow during time of fires?*
29. *Would it be advisable to introduce a special reservoir or standpipe to provide for fire protection?*
30. *Would it be advisable to reserve surplus at the source instead of at some intermediate location nearer the distributing system?*
31. *What material will be encountered in excavating at the reservoir site? (This should be ascertained by test pits, or borings.)*
32. *What is the estimated cost of excavation per cubic meter at the reservoir site? estimated cost of concrete in place at the reservoir site?*
33. *If the ground slopes rapidly at the reservoir site, submit a one meter interval contour map of the chosen site including sufficient area above and below this site so that several other trial paper locations at different elevations can be made on the map.*

## DISTRIBUTION SYSTEM:

34. *Make a house survey of the town, that is, upon a map indicate the number and kind of houses in the different parts of town (flimsy frame, bamboo or nipa; stone; wood; tile or iron roof; one story; two story etc.)*
35. *How many houses are there in the entire district to be supplied with water? What do you estimate to be the average number of people living in one house? Note if this information checks approximately your answer to paragraph 4.*
36. *Will people of outlying barrios not covered by the proposed*

## DISTRIBUTION SYSTEM—continued.

- system come to the system for water? If so, state number that will come over each route. Show routes on map accompanying report.*
37. *If the town is likely to expand, indicate on the map in what direction and to what extent this is likely to occur.*
38. *What provision do you recommend to meet this expansion?*
39. *Furnish a map of the district to be supplied with water showing streets on which fire mains and small service pipe should be laid, best locations of fire and service hydrants, elevations at all corners and breaks of grade.*
40. *Will it be advisable to provide sufficient pressure for house service? For fire?*
41. *Do you consider it best to construct a distribution system for domestic water supply purposes to be reinforced by fire engines in case of fire?*
42. *If the town is so situated that there exists in it a wide range of elevation, do you consider it best to install high and low services with separate reservoirs to care for the different zones? If so, indicate locations of reservoirs on the map and demarcate the zones.*
43. *What is your estimate as to the amount of fire protection needed? (Gallons per minute.)*
44. *Should combination service and fire hydrants be used or should the hydrants be separate?*
45. *State approximately the number of houses that will install a piping system.*

## FINANCIAL:

46. *Give an estimate of cost of land necessary for right of way, reservoir, pumping station or other purposes. What are the assessed values of these lands?*
47. *If pipe is to be purchased in Manila, to what port will it be shipped, and what will be the cost of transportation—*  
 (a) *Per tonne from the port of delivery to the town to be supplied?*  
 (b) *Per tonne-kilometer from the town to the site of the work?*
48. *Give, if possible, the approximate amount of fire insurance carried by the people of the town.*
49. (a) *What is the total amount of assessed property in the municipality?*  
 (b) *What are the total revenues of the municipality?*  
 (c) *What are the total debts of the municipality?*  
 (d) *What funds are available for the work as contemplated?*  
 (e) *What is the ability of the town to make yearly payments?*
50. (a) *What revenue will be furnished by the system?*  
 (b) *What will be the yearly operation costs of the system?*
51. *Give estimated cost of—*  
 (a) *Common labor, per day.*  
 (b) *Carpenters, per day.*  
 (c) *Capataces, per day.*
52. *What are the present surcharges in the province?*

## MISCELLANEOUS:

53. *If the source of supply is of sufficient quantity and has sufficient fall, then, regarding the possible installation of an hydro-electric plant for lighting and power purposes give data—*  
 (a) *What demands are there for power? Enumerate the possible users of power stating how much each one may likely require.*  
 (b) *A total of how many candlepower do you estimate would be required for street lighting? for house lighting?*  
 (c) *How many kilowatts would be required for power? and at what hours during the day?*
54. (a) *Could surplus water from the pipe lines be sold for irrigation purposes to be used on irrigable land near town?*  
 (b) *Submit a contour map showing the location of this irrigable land relative to the pipe line.*  
 (c) *What would owners be willing to pay per hectare for water rights?*
55. *Include any information not covered by the outline, which, in your opinion, should be taken into consideration in the preliminary report. Give any additional information which you consider necessary in a final report.*



# EXPLANATIONS.

The matters indicated in the outline above are in general so well understood by all district engineers that detailed explanation thereof would be superfluous. Special mention, however, will be made of a few items which because of their individual importance may well be emphasized.

## FUNDAMENTAL FACTS.

Among the items of information to be ascertained in collecting data for a proposed water supply there are two that stand out prominently, viz: (a) What demands will be made for water on the proposed system? and (b) Is there sufficient water to satisfy these requirements?

In order to ascertain the demands which will be made upon a new system, especial attention must be given to the question of the population to be served. In the absence of a census of the district, a careful approximation of the number of people to be supplied must be made. Municipal officials should be able to give very closely the population of the poblacion and the various barrios. A study will then have to be made, on the ground, as to what extent the people of various barrios will use the system. In some cases, as for instance at Taal, Batangas Province, people for many kilometers come from several directions to town to get water. Such a condition as this will have an important bearing on a proposed installation.

Then, too, since the town for which the scheme is being projected may increase in population, even very considerably, within a period of a few years subsequent to the installation of the system, the plant should be so designed that this increase in population may be cared for.

The amount of water "used" per capita varies considerably in different towns. Undoubtedly the amount actually needed for domestic purposes could be restricted to 20 gallons per capita per day. However, in most towns, there is much wanton waste, and there are also demands for fire protection, for sprinkling, and for manufacturing purposes which may greatly increase the unit consumption. Eight years ago Manila required 27 gallons per capita per day. At the present time, due to many causes among which is the installation of the new sewer system, the per capita consumption has risen to 57 gallons.

It may be said in general that a system capable of supplying at a reasonable cost 20 gallons per capita per day based on a population twenty years in the future, in a town in the Islands with no manufacturing, should be considered worthy of development. In such a case strict measures should be put into force to suppress all waste of water.

In order to answer the second question, "Is there sufficient water to satisfy the requirements?" the discharge of the stream must be measured. In the measurement of small streams in the dry season, especial care should be taken to get accurate results.

The weir is the most commonly used device for measuring streams of small discharge. For the manner of constructing weirs, reference may be had to such books as Merriman's *Hydraulics*, Lea's *Hydraulics*, Church's *Mechanics of Engineering*, or the admirable article on hydraulics in *Encyclopedia Britannica*. Trautwine illustrates the construction of standard weirs, both "suppressed" and "contracted," in the chapter on hydraulics, in figures 20, 21, and 22. This handbook gives a convenient table of weir discharges for heads from 0.01 foot to 2.50 feet based on the Francis formula.

One of the most important of the formulae that have been devised for computing discharges over standard thin-edged rectangular weirs is the Francis formula which has the form—

$$Q=3.33 LH^{\frac{3}{2}}$$

In this formula,

$Q$ =discharge in cubic feet per second.

$L$ =actual length in feet of weir crest for a suppressed weir, or length corrected for end contraction for a contracted weir.

$H$ =head in feet corrected for the effect of velocity of approach, or it is the "observed" head in feet if there is no velocity of approach.

The Francis correction for velocity of approach is cumbersome. A practical method of allowing for velocity of approach is to substitute the observed head, which may be designated by  $h$ , for  $H$  in the formula and solve the resulting equation,  $Q_1=3.33 L h^{\frac{3}{2}}$  for  $Q_1$  which is a very close approximation to the true  $Q$ . Then since the area,  $A$ , of the channel where  $h$  was measured is known from measurement, the approximate mean velocity of approach  $=\frac{Q_1}{A}$ , from

which the velocity head can be computed  $\left[=\frac{v^2}{2g}\right]$ . The head,  $H$ , can then be obtained by adding the observed head,  $h$ , and the velocity head. The equation  $Q=3.33 L H^{\frac{3}{2}}$  can then be solved for  $Q$ . The result is accurate within a small percentage.

If the weir is one with end contractions, Francis specifies that the actual length of the weir crest should be diminished in his formula by  $\frac{1}{10} H$  for each end contraction. With two full end contractions the Francis formula then becomes

$$Q=3.33 (L'-\frac{2}{10}H) H^{\frac{3}{2}}$$

in which  $Q$  and  $H$  are as hereinbefore defined, and  $L'$ = the actual length in feet of the weir crest.

In placing the weir and making the observations, the following are some of the principal practical points to be kept in mind:

(1) If possible, a stilling pool should be formed just above the weir so that the velocity of the stream may become about one-half foot or less per second before reaching the weir. In this case the velocity of approach is practically negligible. If to do this is not feasible, then the velocity of approach in the leading channel should be rendered as uniform as possible.

(2) According to Francis' specifications, weir dimensions should not exceed the following limitations:

(a) The length of the crest,  $L$ , should be at least 3  $H$ .

(b) In order that the nappe may be perfectly aerated, the fall below the crest level on the down stream side of the weir should be not less than  $\frac{1}{2} H$ .

(c) The depth of the leading channel should be at least 3  $H$ .

(d) In the case of contracted weirs, in order that the contraction may be complete the side width (illustrated as "as" in fig. 22, hydraulic's chapter, Trautwine) of the leading channel should be at least equal to  $H$ .

(3) The depth on the weir should be measured at a point far enough upstream from the crest so that effects of surface curvature, caused by the discharge, may be avoided. The distance upstream to the point of measuring the head was taken by Francis at 6 feet, and this distance is frequently used in the average weir.

(4) The upstream crest edge should be sharp and smooth.

(5) The overflowing sheet should touch only the upstream crest corner.

(6) The upstream face of the weir should be vertical and at right angles to the stream.

(7) The crest should be level from end to end.

(8) The measurement of head should show the true actual elevation of water surface above the level of the crest.

(9) Such wings, floor, and other protection should be used in connection with the weir board as the character of the material and the size of the stream necessitate in order to secure a water-tight and stable structure.

## HYDRAULIC RAM.

The hydraulic ram is a most useful device for elevating water and should be given consideration in every installation where it is possible. On account of the small expense of operation, a ram installation is usually superior to any other, except a gravity one, and there are many cases where a ram has been installed at less cost than a gravity system and with equal satisfaction.

Commercial sizes of rams operate under a power head as low as 3 feet and with as low as two gallons per minute, and as high as 700 gallons per minute. Operating in batteries they have been made to elevate large quantities of water through pipe lines several kilometers long.

With a double-acting ram it is possible to pump water from a pure supply by means of power contained in water from an impure supply.

## HYDRAULIC GRADIENT.

Much trouble may arise in the operation of water-supply systems, both gravity and pumping, by lack of attention being given matters pertaining to the hydraulic gradient of the pipe line. A general discussion of the hydraulic gradient of pipes conveying water is given in Frye, in the American Civil Engineers' Pocket Book, and an especially full one in Trautwine. Attention is called here chiefly to the practical application of these very important principles in the design and operation of pipe lines.

Briefly, the hydraulic grade line is a line of "zero pressure." To illustrate: if at various places in the top of a pipe line under pressure, small tubes (piezometers) be inserted, open to the atmosphere at the upper end, and water be allowed to enter these small tubes from the pipe line, the surface of the water in the tops of these tubes will lie in the hydraulic gradient of the pipe line.

Without detailed explanation, the following facts are quite apparent from the piezometer illustration: First, that if a pipe line lies below its hydraulic gradient the line is under pressure; second,

shallow trench from A to F. It never operated to capacity; a person at the air vent at C and at the outlet at F could observe that the pipe was only partly full at those places.

It is quite apparent that if it were practicable to have laid the pipe in a straight tunnel bored through the hill from A to F the pipe would have run to capacity and have been without pressure from within or without. If the pipe were laid below such a line, AF, it would have run to capacity and have been under pressure also. But being laid above the straight line AF, the pipe was in suction, and since the joints of the soil pipe were leaky, air found its way into the pipe causing the pipe to act simply as a trough. It is apparent that a 4-inch trough laid from A to D would not bring the water to D so rapidly as a 4-inch trough laid on the steeper grade from D to F would take it away from D; hence the phenomenon of small discharge in the pipe.

This condition would not have occurred if the pipe from A to D were 6-inch instead of four. The hydraulic gradient for such a combination of 6 and 4-inch pipe works out as shown in figure 1. A calculation shows that when the 6 and 4-inch lines are running to

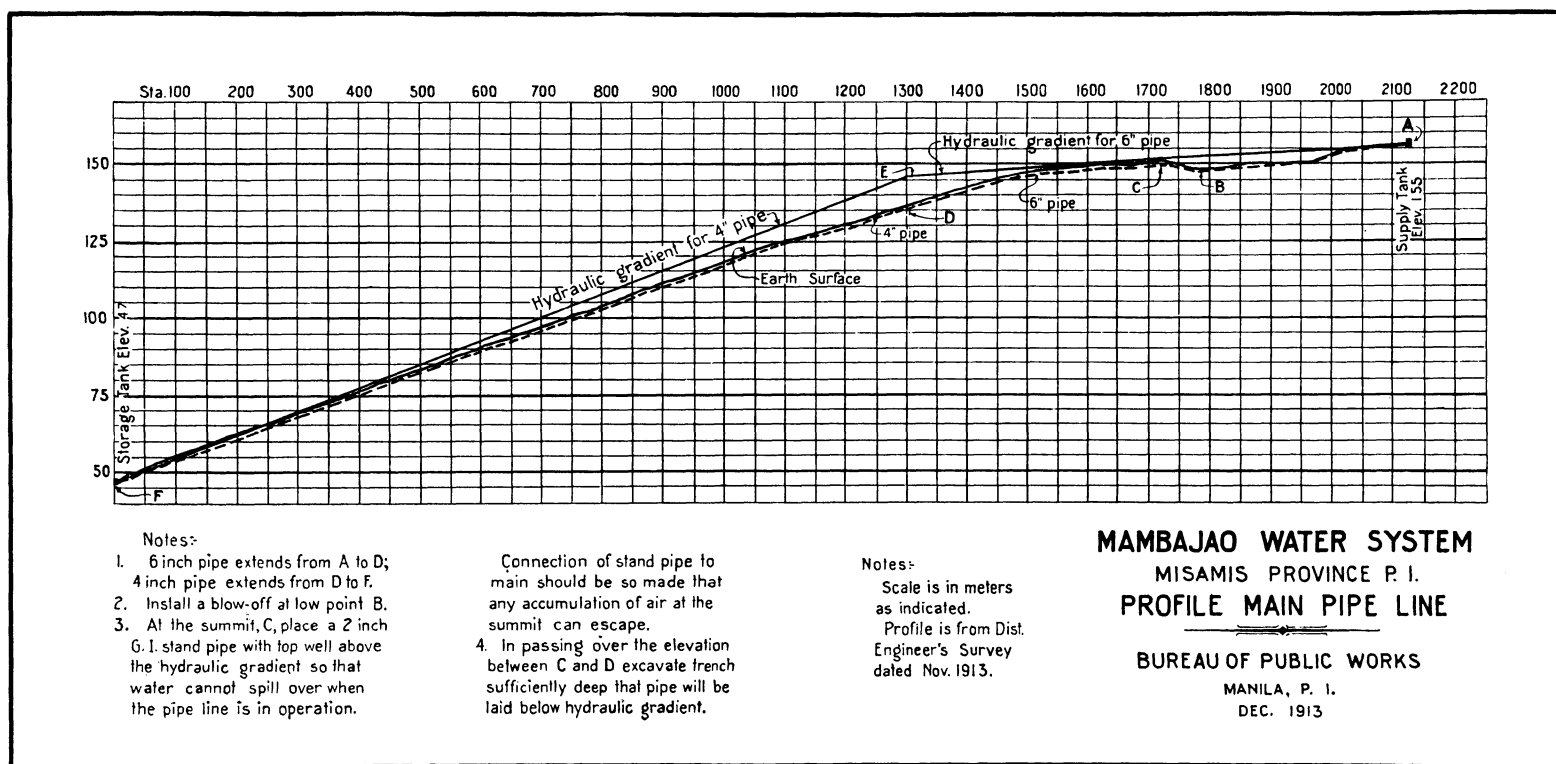


Fig. 1.

if it lies along the gradient it is under zero pressure (this is the condition present in the water at the surface of a trough, a gutter, or a river); and third, if the pipe line lies above the gradient it must be in suction, that is, the pressure is no longer outward but inward.

It is also apparent from the piezometer illustration, that if a pipe line be of uniform diameter and if the resistances within it to the flow of water be uniform per horizontal unit of length the hydraulic gradient will be a straight line throughout the length of the pipe. If however the resistances are not uniform (as is the case when a pipe line consists of pipes of different diameters, or of pipes of the same diameter but of different degrees of roughness), the hydraulic gradient will be straight only in those portions where conditions are the same, and therefore the gradient line must necessarily contain an angle wherever conditions change from one state to a different state. In the illustration (fig. 1), the hydraulic gradient makes an angle at E, as shown, at the juncture of the 4-inch and 6-inch pipe lines, and is straight throughout the 4-inch and throughout the 6-inch line.

The application of these matters can best be made clear by an illustration. Figure 1 shows a profile of the Mambajao pipe line. This pipe line was laid some years ago with 4-inch soil pipe in a

capacity about 9 meters of head are lost in frictional resistance in the 6-inch pipe up to point D. By plotting a point E vertically over D and 9 meters in elevation below the supply tank, EA and EF become the hydraulic gradients of the 6-inch and 4-inch lines, respectively. It is seen that with little excavation the pipe lines could be laid below the hydraulic gradients so drawn. As a result both 6 and 4-inch pipes would operate under slight pressure throughout their entire lengths; no suction could possibly occur in either pipe; and the system would then operate to full capacity.

Incidentally, in connection with the same pipe line, another matter of interest may be mentioned which should be carefully looked after in the installation of all pipe lines where summits in the line cannot be avoided. The records show that when the water was turned on at A no flow occurred at F. Finally a hole was drilled in the pipe at C, freeing the "air bound" pipe from the accumulation of air which had collected at the summit, after which some water issued at F.

## GENERAL MAP OF TOWN.

Figure 2 is intended to suggest in a general way the information a map of the town should contain to assist the designer in laying out the distribution system. This illustration also shows a convenient way of representing this information. Such matters shown thereon

as the house survey, the suggested location of mains and of fire and service hydrants, the indication of the direction of future growth of the town, the representation of the routes over which people from outlying barrios will come for water, the information as to which are the provincial highways and the principal thoroughfares in town, the notes describing the location of the business and residential districts, should all be at hand for the designer's consideration when the sizes of the pipes are computed and final decision made as to location of street mains.

In locating fire hydrants within the area to be protected, it is usually advisable to place them near enough together so that the desired amount of water may be obtained without using lines of hose longer than 300 feet. In a gravity system, considerations of the large loss of head in hose may demand close spacing of hydrants.

of Oregon pine. With the passage of time and the frequent raising and lowering of temperatures to accommodate articles in storage requiring different temperatures, the consequent condensation of moisture when these changes occurred tended to keep the Oregon pine beams, posts, and floors in a semiwet or damp condition.

In 1910 some of the wooden floors began to fail under the customary loads, thereby causing a loss in revenue by having to adopt a system of lighter loads. In the latter part of 1910 plans were prepared by the Consulting Architect for the reconstruction of the cold-storage sections, using reinforced concrete and modern methods of insulation.

The actual work of reconstruction commenced in the latter part of 1911, the first operations consisting of reconstructing two small rooms over the main driveway.

While the plans were in course of preparation, considerable discus-

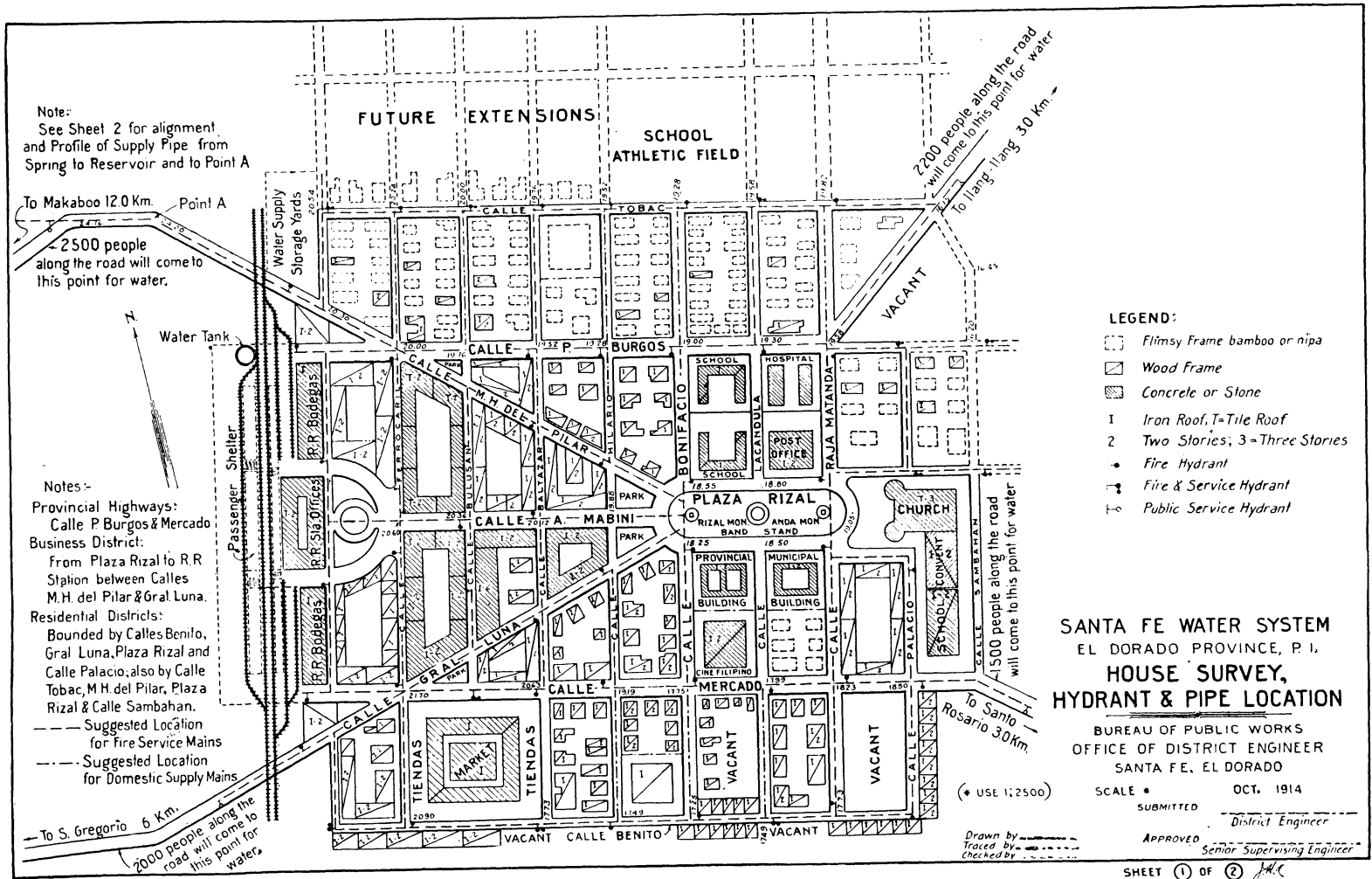


Fig. 2.

Furthermore hydrants are cheaper in the long run than hose. Since a hydrant in place does not cost over ₱70, the percentage of the total value of the system which the hydrants represent, is usually found to be small. The location of fire hydrants, therefore, fairly close together, should prove a good investment.

In making a map of the kind illustrated, due care should be exercised in the selection of the proper scale. One smaller than 1:2500 makes the details too crowded and is likely to result in considerable inaccuracy in scaling pipe lengths for the final estimate.

## RECONSTRUCTION OF THE INSULAR ICE PLANT.

By J. MCGREGOR, Structural Engineer, Bureau of Public Works.

The cold-storage sections of the Insular ice plant as originally constructed in 1901 consisted of brick masonry external and internal walls, while the floors, columns, and interior structural members were

sion developed regarding the class of insulation to be adopted, but by reference to authorities on cold storage and through the practical experience as reported by ice-plant operators in the United States, it was decided that granulated cork of sufficient thickness would be suitable for the purpose. It was found later that the use of granulated cork unduly increased the cost of the finished structure, owing to the difficulty to thoroughly compact the cork in the double floors, walls, and ceilings. When the two rooms above mentioned were finally placed in operation it was further found that the keeping up of a low temperature was not so economical as had been anticipated.

Bearing in mind the results obtained from the first two rooms, the plans for the five large sections were revised and boards of hydraulic compressed cork, cemented with asphaltum to each other and to the concrete, were specified in place of the loose granulated cork. The first large section, No. 1-6, was commenced early in 1912 and completed approximately eight months later. Subsequent operation of this section has demonstrated that the cork board is far

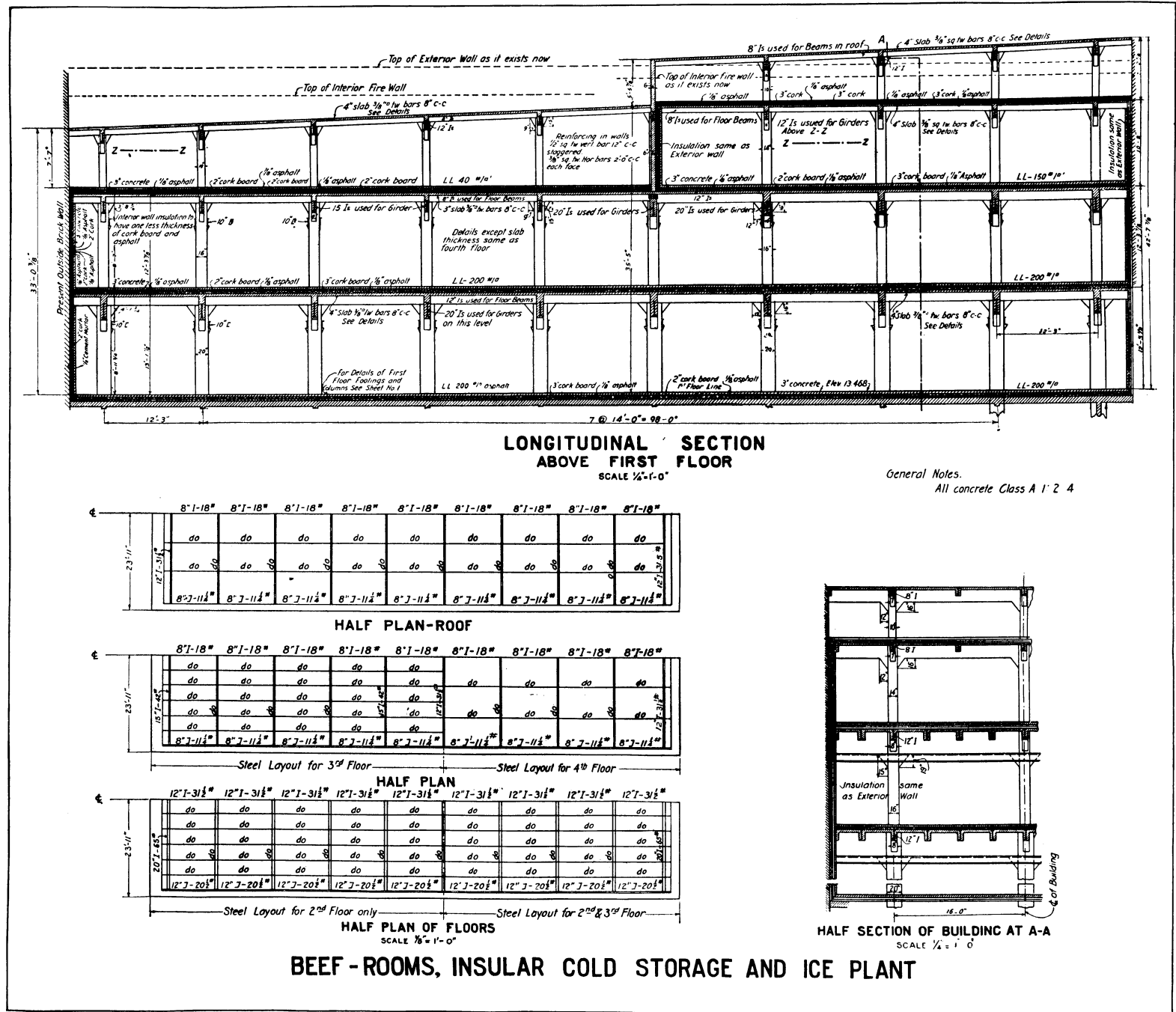
superior to the granulated cork, both in ease of manipulation and its more thorough retention of temperature.

The cork board in the first section was of English manufacture, but samples submitted later of American cork board proved that, though slightly more expensive, the American cork board was superior in quality and compactness to the English variety and this was therefore used in the remaining four sections.

The cost of each section is approximately \$120,000, and at the time of writing four sections have been completed and placed in

per square foot were obtained. Based upon this assurance, construction was inaugurated on section 5-10 as soon as section 1-6 had been completed. The foundations consisted of a flat concrete raft built monolithic with the supporting piers, but independent from the old interior and exterior brick walls. The cold-storage rooms are superimposed upon the raft and are isolated at all points from the old walls so that should any settlement occur it will be independent of the old structure.

The section as completed consist of the raft, first, second, and third

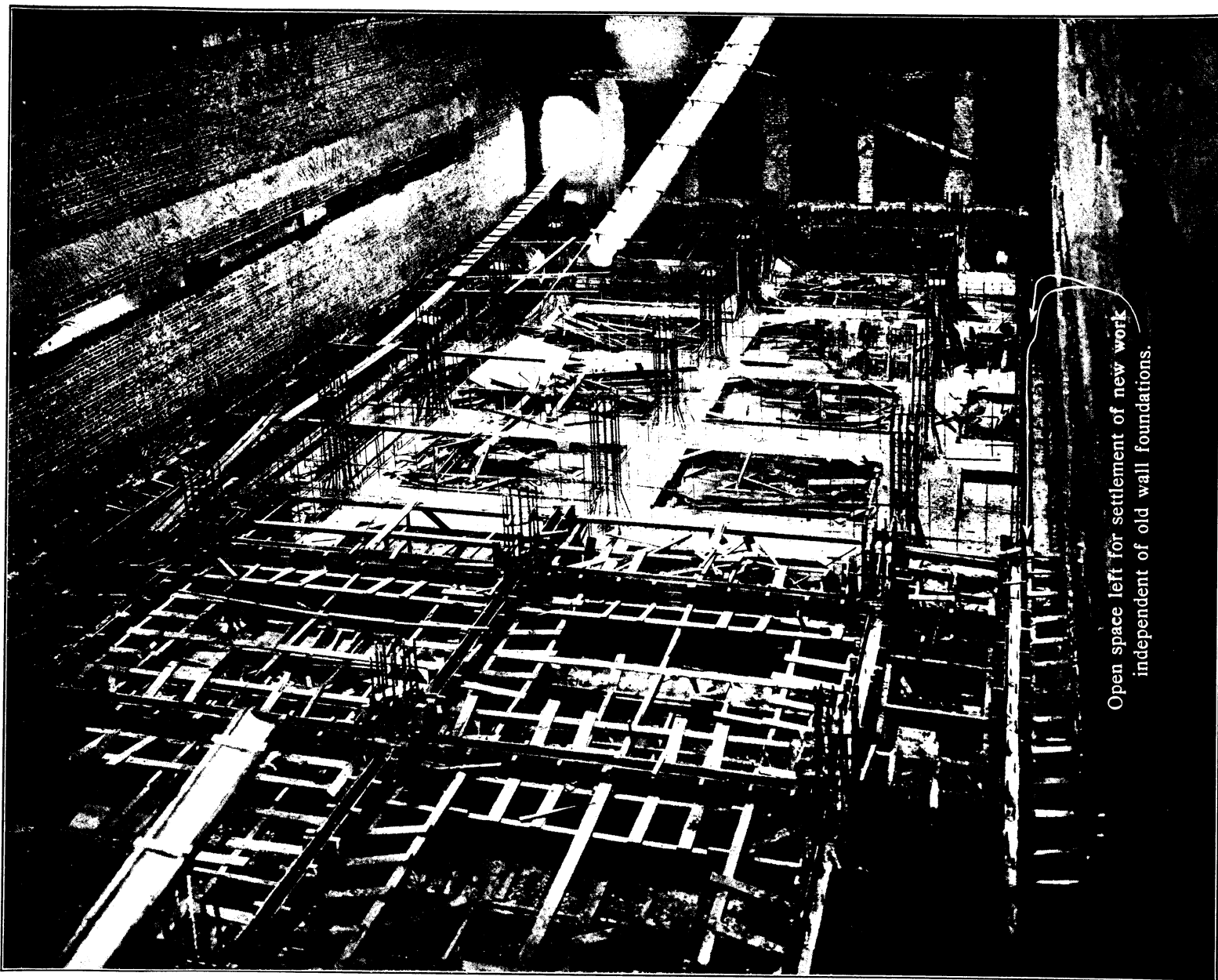


operation while the fifth is in course of construction. The approximate time required to complete each section is from one hundred and twenty to one hundred and fifty days.

The old foundations consisted of isolated piers formed of granite and concrete into which were inserted the vertical pine posts supporting the floors and meat rails. These posts were continued in short scarfed sections to the second and third floors and finally supported the roof.

Prior to the pouring of the new foundations the soil was carefully tested for bearing power and results approximating 2,000 pounds

floors, and roof. The first and second floors accommodate a live load of 200 pounds per square foot while the third floor will take 150 pounds per square foot. The roof is a flat concrete slab upon which prepared roofings have been installed, different makes being used on different sections with a view of obtaining reliable information that will show when conditions are identical and, all things being equal, which is the better roof. The roofings used thus far have been Carey Standard Roof, supplied and installed by the Cooper Company, of Manila, under a ten-year guaranty, and the Pabco Reinforced Malthoid Roof, supplied and installed by Norton-Harrison



Reconstruction of refrigerating rooms, Insular ice plant.

Open space left for settlement of new work independent of old wall foundations.

Company, of Manila, also under a ten-year guaranty. On another section a still further experiment has been made by installing on the concrete roof slab a flat, standing seam, 22-gauge, American ingot flat galvanized-iron roof. The standing seam is made in accordance with the standard adopted by this Bureau and exhibited at the 1914 Philippine Exposition. There is a slight advantage in the iron roof, inasmuch as laborers and mechanics can use the same for readily cleaning condenser and ammonia pipes on the roof near to their permanent location instead of taking them down to the courtyard at considerable expense and inconvenience. Its cost is only slightly more than the prepared Carey and Pabco roofs. The cost of application, however, is somewhat higher and, as the roof is entirely flat, it yet remains to be seen whether the maintenance and repairs of leaks will compare favorably in cost with the maintenance of the prepared roofs previously mentioned.

The plant used for reconstruction consisted mainly of an electrically driven No. 2½ Smith concrete mixer, together with the contingent electric elevator, shutes, drops, etc. The largest quantity of work done with this outfit in one day consisted of 150 barrels of cement.

The ice-plant authorities state that the cost of refrigeration and cooling has been reduced some 30 or 40 per cent as the result of reconstruction operations.

### ON THE JOB HERE AND THERE.

Mr. J. W. Graham, formerly district engineer of Misamis and Batangas, is now with the Ohio State Highway Commission. He recently made a tour of several cities in the East in connection with his work for the Highway Commission.

Mr. F. D. Nash, a former division engineer, is in the employ of the Chicago and Northwestern Railway with headquarters at Chicago, Illinois.

Mr. L. W. Scheidemantel, district engineer, who has been spending his vacation at San Antonio, Texas, will return to the Islands shortly for another tour of duty.

Mr. A. T. Sylvester, formerly district engineer of Occidental Negros, is now located at Baker City, Oregon.

Mr. J. C. Cookingham, who will be remembered as district engineer of Samar, has been heard from at Syracuse, New York.

### PROJECT NOTES FROM DISTRICT ENGINEERS.

#### ALBAY.

During the past quarter the work on the construction of the Tabaco and Guinobatan markets and tiendas, contracted by Mr. B. F. Mills, has progressed very satisfactorily, considering the scarcity of materials. The Tabaco work will be completed by the 1st of October and

the Guinobatan work about a month later. Work by administration was begun on the Oas market the 1st of August, and will be completed the 1st of November, if roofing iron can be obtained, which seems doubtful at present. Materials have been ordered and work will be begun within a month on a small market in Camalig. When the above work has been finished the present market-construction program for the province will be completed.

There are at present under construction two 2-room barrio schools in Malinao by administration and one in Guinobatan by contract. Work on the construction of two 2-room barrio schools in Tabaco is about to begin. These schools will all be finished easily by January 1st. Work on the Polangui School, plan No. 7, has been suspended on account of lack of funds. The site has been graded and materials are now being delivered for a standard plan No. 10 in Guinobatan. This work will be done by administration with ₱21,672 available for expenditure, which is believed to be ample.

During the past quarter no road work has been done except the regular maintenance and the surfacing of about 2 kilometers. With the coming of the rains all roads except 6 kilometers of the inter-provincial road have shown great improvement. Kilometers 45 to 51 of the interprovincial road passes through a swamp and the grade is made of a very sticky gumbo with surfacing only 3 meters wide. The heavy trucks loaded with from 50 to 75 passengers have been too much for it. In many places deep ruts have formed, mixing the surfacing with the slick mud. It is proposed to fill these ruts with large boulders and to place another heavy course of surfacing, 4 meters wide, over the whole of the 6 kilometers. Patching was tried but failed, partly because the road is so narrow that tracking cannot be prevented, and partly because the patches failed to shed the water properly. The work has been started during the present lull in the rains.

A new 10-ton Buffalo-Pitts road roller has recently been received. The province now has 3 road rollers, one of which, however, is practically ready for the scrap pile.

A small job of culvert construction and repair has been completed for the municipality of Bacacay. A concrete curb around the plaza is being constructed in Daraga.

The Bato-Viga Trail on the island of Catanduanes has been completed and open for traffic since July 2. The total length is 55 kilometers. It is now an easy day's trip on horseback from Virac to Viga, with beautiful scenery and good drinking water all the way. The construction of a 1-meter trail from Codon to Manombrag is now under way.

Plans are being prepared for presidencia buildings for Bato and Baras, Catanduanes.

#### AMBOS CAMARINES.

During the past quarter 5 kilometers of first-class road, and two culverts, one 4 by 2 and 1.5 by 1, were constructed in the Partido-Lagonoy District. A concrete roadway was laid across the Rangas River, which was heretofore impassable after every hard rain. Automobiles and trucks can now pass throughout the district without difficulty.

Grading has been started on the Tigaon-Salvation Road.

An investigation has been made of the Sagñay-Iriga Trail as a probable location for a road, but while this location opens up considerable new land and an extensive forest, the grades would be practically prohibitive. The economical location for this road is Tigaon-Mabatobato-Paulli, connecting with the Naga-Boundary Road at kilometer 18.

All projects in this province have suffered for lack of laborers. The Manila Railroad Company is recruiting a large proportion of its laborers from the Bicol Provinces, which makes a shortage here. On the railroad work near Bato, the daily wage has been increased to 80 centavos per day, while the province on an adjoining project is still paying 60 centavos.

The block of four 4.5 by 5 meter tiendas at Bato will be completed by October 1. Bato is the first municipality in this province to install modern market and tienda buildings.

A loan of ₱16,000 has been granted to the municipality of Nabua for the construction of a market building.

The Iriga market building has been dismantled and reconstructed as a standard type 21 by 39 meter building on a new site. The reconstruction was completed September 1. Work on the block of 12 double 4 by 6 meter tiendas will be started by administration upon the arrival of material.

During the baguio of June 18 the municipal building of Buhi was so badly damaged that repairs were considered inadvisable. The municipal council has recently requested an estimate for a standard plan, Scheme C, municipal building.

The contract for furnishing the fabricated steel and field rivets, for the Balos River Bridge in the municipality of Iriga, was awarded

to the Atlantic, Gulf and Pacific Company. Contract price, ₱8,100. This is to be a 45.72-meter through Pratt truss.

The Magarao culvert, a standard reinforced-concrete box 5 by 2, was opened for traffic August 1.

Work was started by administration on the Anayan Bridge on July 15. A turnout has been constructed, the excavation completed and concrete placed in one abutment. Work will be completed about November 1.

The Naga market camarin will be completed about October 15. This is a standard 21 by 39 meter building. Work on a block of 10 double 4 by 5 meter tiendas will be started immediately.

The reconstruction of the San José municipal building is limited because of lack of funds, and the work is being carried on in the following order: (1) Galvanized iron roof, (2) new windows and doors, and (3) concrete floor on first story. The walls of this building are fine examples of old Spanish masonry in an excellent state of preservation.

#### ANTIQUE.

Those sections of the Patnongon-Pandan second-class road, where extensive repairs are needed and where the provincial road is sure to pass, are being maintained with the regular cross section of first-class road and with a ruling grade of 2½ per cent, so as to eliminate future building of subgrade and so as to be ready to take the surfacing materials as soon as money is available.

Grama grass has been planted along this road to prevent the future growth of other kinds of grass, weeds, etc. It has been observed that where grama grass has grown successfully in abundance, weeds and other grasses have been suppressed, and that the section of the road has kept its regular form.



Central barrio school, Lauaan, Antique Province.

In order to facilitate the transportation of future crops of rice, sugar, and corn in November and December and succeeding months, capataces from the construction gangs have been transferred to the maintenance of the following second-class roads: Patnongon-Pandan, Sibalom-San Remigio, Sibalom-Egaña, Egaña-Malandug, Mapatag-Dao, and Dao-Casay.

Apgahan Bridge on kilometer 19, San Jose-Patnongon Road, a single span 9-meter reinforced-concrete girder, was completed in August at a cost of ₱4,440.82.

An additional appropriation of ₱1,000 was made recently by the provincial board to continue the construction of the Patnongon-Pandan Road. The work is now on kilometer 26.

The construction of San Jose-Dao Road is going on in spite of the rainy weather, and 2 more kilometers of subgrade have been completed ready for surfacing. The work is now on kilometer 19, lacking but 9 kilometers to reach Dao, the last southern town of this province.

The survey of the Caritan-Bugason Road has been completed. The construction of the road next year will give the province a total of 67 kilometers of first-class roads. An automobile line to take passengers and freight should do well on this road.

The first of the towns of Antique Province to follow the example of San Jose in passing a resolution guaranteeing the payment of one-third the cost of successful artesian wells is Sibalom. The other towns will no doubt follow.

The Lauaan Central Barrio School, a standard plan No. 3, has been completed at a cost of ₱8,533.07.



**BATAAN.**

Two kilometers of the road from Balaña toward Orion have been surfaced with gravel to the standard depth, and 1 kilometer on the same road, between the barrios of Bantan and Caluñugusan, has been brought up to first-class condition.

The houses in the barrio of Calaguiman on the Balaña side of the bridge have all been moved and the road converted to the standard width, so that now the barrio offers a much healthier district for the people and a much safer wheelway for traffic.

The planting of shade trees along the first-class roads was completed about the beginning of the rainy season and it is interesting to note that almost all the acacia and api-api trees are growing well. Other trees, such as mangoes, tamarinds, santols, mabolos, and duhats can not easily be judged at present as to whether they will continue to grow.

On several portions of the newly dug canals of the Pilar irrigation system, especially where the soil consists of sandy loam, the banks slid down, due to heavy rains; however, repairs are being pushed in order to keep the system in serviceable condition for the next two months during which the water is especially called for on the rice land.

A new artesian well has recently been drilled on the Orani Plaza in front of the presidencia. It is 230 feet deep and flows 70 gallons per minute of good, potable water.

An athletic field has been laid out for the high school at Orani, but as no funds will be available this year the grading will be done by the students under the supervising of the district engineer.

The recent continuous rainfall for over three weeks caused the mountain creeks to pour so much water into the rivers below that considerable damage has been done. Several places where the water was not able to creep before were reached this time. The fields were converted into lakes, so that bancas came in handy as means of transportation.

The northern part of the province for over 6 kilometers was completely flooded, the water on the roads rising to such a height that small culverts went out of sight, and bridges showed nothing but their balustrades. The rice crops on both sides of the road from Hermosa to Dinalupihan, a distance of about 6 kilometers, were seriously damaged.

**BATANGAS.**

The Batangas provincial rock crushing plant has been in continuous operation since April 13, 1914, a sufficient length of time to make data on its performance of interest. The plant as originally acquired was a secondhand outfit in reasonably good condition and consisted of a portable No. 4 Champion rock crusher with elevator and revolving screen with one portable Farquhar engine and boiler of suitable size. To this has been added an elevated portable storage bin for economically handling the three sizes of stone produced; 1 kilometer of tramway with 10 dump cars of 0.5 cubic meters capacity each and one small "swinging engine" used for handling the dump cars. As the plant is now working in a thickly populated section, a small water system supplied by a steam duplex pump has also been installed in order to allay the dust nuisance around the crusher and bin, and for service in case of fire.

During the period covered the crusher has been operating on the beach at Santa Clara, the port of the town of Batangas. Hard boulders of the grade commonly known as "niggerheads" are supplied at a contract price of ₱2 per cubic meter in storage pile by boats varying in capacity from 1 to 15 cubic meters. This stone is procured on the seashore at a point possibly 12 kilometers distant. The boulders are loaded into the dump cars by a few, usually 5, laborers working at the storage pile. Seven tramway spurs are used to insure prompt and economical loading. The cars are hauled by the hoisting engine from the loading point up an incline to the feeding platform. All crushed stone not taken from the storage bin is hauled by tramway onto one of two trestles where it is stored. As the engine used for this purpose has two drums it is frequently used for hauling boulders to the feeding platform, while at the same time it is hauling crushed stone to a storage pile. Thus, from the time the boulders are loaded on the cars until the stone is on carretones being hauled away or is in a crushed stone storage pile very little hand labor is expended on it.

The plant is operated as a manufacturing project and is under the immediate supervision of the district engineer. The stone is issued to various projects the same as materials are issued by the provincial treasurer. The issue price for the finished product is ₱3.20 per cubic meter f. o. b. at the crusher. This price is intended to cover the contract cost of the boulders, the cost of handling and crushing, the cost of all repairs, including the purchase of spare parts, the cost of all other expendable material, rental of tramway and surcharges, but does not include any assumed depreciation charge.

A total of 6,742.75 cubic meters of crushed stone has been produced to date (September 20, 1914) making an average working day output of slightly less than 50 cubic meters. A detail statement of the cost of operation follows:

	Amount.	Unit cost.
Supervision	₱562.32	₱0.083
Labor	4,121.19	.612
Coal	2,473.11	.052
Oil and grease	352.59	.052
Crusher parts	342.82	.051
Stone cost	13,454.30	1.695
Miscellaneous	1,787.52	.265
Total	23,093.85	3.425
Uncrushed	6,742.75	cubic meters

NOTES.—Unit cost is for 6,742.75 cubic meters crushed stone produced. "Miscellaneous" is made up as follows:

Lumber for housing crusher and for storage trestles (12,057 board feet)	₱727.34
Construction of one portable stone bin	200.00
One old building bought for roofing iron	80.00
Rentals, tramway equipment (May to August)	500.54
Rope, etc., and transportation	279.64
Total	1,787.52

Some damage and considerable inconvenience has been caused by the recent unprecedented floods. The Calumpang Dikes suffered to the extent of approximately ₱2,300, but the concrete terminals standing on piles, even though the flood washed around and under them, remained intact. Several washouts occurred on the causeway over the tidal flats on the Lemery-Calaca Road due to the Pansipit River overflowing its banks and cutting across the country. These have been repaired, and the largest washout, about 30 meters, is being bridged in anticipation of future floods. Other minor damages occurred throughout the second and third class road systems, but the principal routes are now open to through traffic.

Preliminary investigations for the Mataywanac and Kaytitinga Bridges, both 15-meter arches, and the Palico Bridge, which is to be a steel structure approximately 130 meters long, are under way. These are all on the new Tuy-Nasugbu section of the Batangas-Nasugbu Road. Road construction will be opened again on this road as soon as the weather permits.

The Nasugbu central school building, standard plan No. 10, is very nearly completed. The Ibaan building, standard plan No. 3, is likewise nearing completion, 80 per cent of the construction being finished.

The Tanauan market building, a 30 by 43.50 meter "no-court type" building, has just been started by administration. The Batangas buildings and tiendas are still under consideration by the municipal council of Batangas.

Since last noted in the BULLETIN, six successful artesian wells have been completed in the province. Four of these are in Batangas and, while they are pumping wells, the water stands very close to the surface and may be procured in practically unlimited quantities. The remaining two are in Bolboc (formerly San Juan de Booboc) and these are both flowing wells, one flowing 5, the other 15, gallons of water per minute from a depth of about 600 feet.

**BOHOL.**

Most of the construction jobs in the province have been completed and but few new ones are being authorized, hence public works are almost at a standstill. Road work is going on from Loboc toward Bilar and also near Guindulman along the new location. This new road, being located along the beach, will not be subject to damage from the monsoon.

The road from Guindulman to Anda is now passable for vehicle traffic. The road to Antequera, which connects with the Tagbilaran-North Road at kilometer 11, is also being repaired and will soon be passable. The Tagbilaran-Corella Road is also being worked. These are all third-class roads which do not require much work to make them reasonably passable.

All culverts from Tagbilaran to Duero are now completed, as are also those from Tagbilaran to Canogon, a barrio of Tubigon, kilometer 61.

Tubigon, Inabanga, and Jetafe school projects have been completed. The Taloto school building has also been completed by Mr. B. Hagans, contractor. The work originally provided for on the Duero reconstruction project is almost completed, but the municipality has made an additional appropriation in order to complete the work more fully. The Bacayon building has been ceiled and is now considered complete.

A block of three 4 by 4 meter standard tiendas has been authorized by the municipality of Tubigon. This building will be constructed in the near future.

Investigation has been made for a water system at Loay and Loboc. There is a spring at Loboc which has a flow of 5,000 gallons per minute. By placing two large hydraulic rams in the stream and another in the line as a relay, this water can be pumped to Loay through Loboc, a total distance of 7 kilometers.



Although this is now the rainy season, there has been almost no rain and the rice and corn crops are suffering severely. All rice crops are failures except those in small irrigated districts. The people are clamoring for work on the roads, but the appropriation balances are too low to allow the increasing of the forces at work. This dry weather has assisted the road work, however, by making it possible to build road embankment through ricefields while they are dry.

#### BULACAN.

Work on the Baliuag market is progressing nicely. The roof is practically completed and the floor is well under way. It is thought that the new building can be occupied by October 20.

The completion of the San Idefonso School has been greatly delayed because of difficulties in securing the timber for the roof. The order for this timber was placed in February, but delivery was not completed until late in August.

The Paombong School, a standard 7-room building, is nearing completion. The roof has been finished and the windows placed. The amount of interior work which can be undertaken will depend on securing a loan from the Insular Government, but as the terms of the loan have been agreed on it is thought that the money should become available within a short time.

The division superintendent is making an effort to secure funds for a 7-room school at Santa Maria and for a 4-room school at Guiguinto. There is very good prospect that his efforts will be successful.

Road-construction work on the Manila-North Road is entirely suspended owing to the heavy rains. The work of placing culverts has not, however, been greatly interfered with.

The heavy rains and consequent floods of late August and early September did considerable damage to second-class roads, but the first-class roads have stood the strain very well, indeed. There has been some damage due to overflow, but the stretches affected have been short and in no cases have the lower courses of the metalling been disturbed.

On September 2 Malolos suffered from the highest flood recorded in recent years. The provincial grounds were covered with a sheet of water 4 to 5 feet deep, and even the driveways, which had been built above the highest previous floods, were submerged nearly 2 feet. No great damage was done to either roads or buildings on the grounds, but everyone living in Malolos was greatly inconvenienced.

#### CAGAYAN.

This province and the whole of Cagayan Valley has been more fortunate during the last quarter than other Luzon provinces to the south in not having had heavy rains. To receive, after a week's sunshine here, a telegram stating that Manila streets are under water and heavy rains still falling, is an impressive reminder of the extent of Luzon Island. A good corn crop has just been harvested and is contributing to mitigate the depression caused by the European war.

Steady progress is being made in the continuation of the Tuguegarao-Alcala Road. The subgrade on the 4 kilometers now under construction between Iguig and Estefania is about complete, and gravel surfacing is being placed as rapidly as one roller can properly prepare the roadbed and bind the surfacing. The asphalted overflow section on kilometer 10 has been completed and is ready for a baguio test.

An Insular allotment of ₱8,961 which was received in May, 1914, is being expended in the construction of a second-class road across the low mountain range that forms the divide between the Cagayan and the Rio Chico Valleys. This road has been relocated across the first ridge and crosses the crest at a much lower elevation than formerly, thereby reducing the grade in places from 10 per cent to 6 per cent. The distance across the range, which is composed of two ridges, is about 8 kilometers, and, as the funds now available are insufficient to complete the work, an effort is being made to open up as much of the road as possible over the new route without working to the required grade line. This road connects the municipalities of Malaueg, Tuao, and Piat with Tuguegarao; and when the system is sufficiently extended will connect the mountain provinces of Apayao and Kalinga with Tuguegarao, thereby giving them the advantages of the Cagayan River as an avenue of commerce and communication with Manila.

Considerable gang maintenance on second and third-class roads has been in progress during the past quarter. While it is difficult to add to the value of the road system in Cagayan Valley by the maintenance of unsurfaced roads, nevertheless, the future development of the system has been kept in view.

Work has been started on the Camalaniugan municipal building, which is to be constructed by administration under the supervision of the district engineer. The building, a 2-story reinforced-concrete structure is estimated to cost ₱16,500.

#### CAPIZ.

The Panitan-Pilar Road and Bridge project is being pushed as fast as funds and labor conditions will permit. The subgrade is rapidly approaching Araguén River (kilometer 38.) Structure and surfacing are completed to kilometer 31.

The present quarry site on this project is one with rare natural advantages. It consists of a vertical ledge, the base of which is some 20 meters above and 200 meters back from the road. Drilling and spalling are done by "paquiao" and the rock ready for crusher is delivered through gravity chutes to tramcars. The loaded cars, three per train, are released and travel 120 meters by gravity over a 3 per cent grade, hauling three empties to their position ready for loading at the foot of the chutes by means of a steel cable running over a drum. The full cars are held in perfect control at all times by means of band brakes applied to the drum, and come to a stop on the crusher platform.

Further, the crushing plant is located at a peak of the profile with sufficient grade over 1 kilometer each way to move the crushed rock out by gravity.

A Bureau of Education plan No. 7 school is now under construction at Ibajay. All the materials are on hand and it is expected that the project will be completed in record time. Lumber and cement were delivered off the beach at Ibajay by special transportation from Iloilo. The fine public spirit of the people of Ibajay again proved itself when some 400 volunteer citizens met the lorchas with bull carts, rafts, and small boats to effect a rapid discharge of the cargo.

#### CAVITE.

The floods during September of this year were higher and of longer duration than any ever before recorded in Cavite Province. It rained continually with scarcely any diminution of quantity from August 28 to September 13. During this time 22 kilometers of first and second-class roads had 1 meter or more of water passing over them. These roads were flooded twice during September floods, being forty-six hours under water at one time and thirty hours at another time three days afterwards.

The damage to surfacing on the broken stone sections while quite serious, was not of a completely destroying nature. Approximately 1 meter of width of surfacing on the flood side of the road was washed out and carried down into the ditch on the opposite side of road, and the binder around the stone was carried away to a depth of 2 centimeters. The 1-meter strip of stone carried away was replaced and rolled, and 2 centimeters of screenings or gravel were placed and rolled over the whole section of road. The embankment was not disturbed at any point, due entirely to the well-sodded slopes, Bermuda grass of about four years' stand. The floods are general and it is impractical to raise the road grades above high water, for sufficient openings to carry the floods would make the cost prohibitive. Asphalt or probably road oils would hold these sections of broken stone surfacing intact during the floods that happen each year, and this remedy will be applied as soon as funds are available.



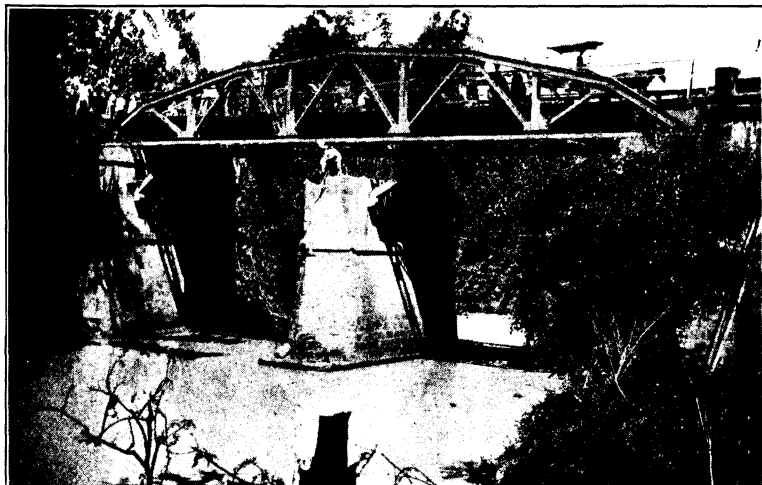
The old Naic Bridge, Cavite Province.

The second-class roads affected were all gravel surfaced with adobe base. Two kilometers of the road from Noveleta to Malabon, a section which lies in the path of the Grande River overflow, was completely stripped of its gravel surfacing, exposing the adobe base as clean as though it had been washed by human effort. All other sections were washed out in short strips where some especially strong current passed over. The whole section submerged was softened to such an extent that heavy traffic did considerable damage

before the roads were closed to cart traffic. About half of the affected road is not yet open to cart traffic at this writing, September 23.

A steel bridge of 80-foot span was erected on old adobe abutments at Naic to replace an old wooden stringer double-span bridge. Photographs show views of pier that is being taken out. This was undermined by scouring and was in a very dangerous condition. Especially good time was made in the erection of the steel by the contractor, the Atlantic, Gulf and Pacific Company. Steel arrived at Naic on August 3, and the bridge was accepted as complete on August 18. Concrete end posts are to be built to receive the ends of angle rails. These add very much to the appearance of the structure.

Several road-construction estimates and plans have been prepared for construction during the coming season, should any funds become available. The longest section is from Noveleta to Cavite, 9.6 kilometers. Its cost is quite high on account of large embankments through sections of Bacoar Bay which are subject to tide and rough weather. It is proposed to reconstruct 1 kilometer of road through Noveleta by raising the grade above high water. This will require a fill of approximately 80 centimeters and one 3-meter culvert. The section through the tide flats of Dalahican will be constructed with two muck dikes, one on each side, the space between to be filled with sand from the beach. Swamp muck will cost ₱1.50 a cubic meter in place, and sand can be moved in for about 60 centavos. The top will have a layer of adobe and then broken stone surfacing. The estimated cost for the section of 1 kilometer through the swamp is ₱25,000, the fill being 2 meters high with 80 centimeters of water at low tide. The total cost of the project is ₱34,000, but a small portion has already been completed in the town of Cavite. This is



The new Naic Bridge, Cavite Province. A single 80-foot steel span, the center pier being removed.

the only vehicle route to the town and the people are very anxious to get the road built. Railway and ferry connections to the town are excellent, however, so the road is not as essential as it would be were there no other ways of getting into town.

The road from Naic Junction to Maragondon is one of the more important agricultural roads and should be constructed. During the rainy season it becomes absolutely impassable. The distance is 5.7 kilometers, and the estimated cost including structures is ₱75,000. This route lies at right angles to the general slope of the surrounding country, running parallel to the beach and to the beach about 2 kilometers from it. It passes through a completely irrigated rice territory and taps the big sugar districts back of Maragondon.

Another road surveyed and estimated for construction is the Bina-kayan Ferry to Kawit (kilometers 20.240 to 23) and includes the Kawit Station Road which is 350 meters from the main highway at kilometer post 23. This strip of road will connect the first-class section from Kawit to the first-class road from Manila.

An excellent artesian well has been driven in the barrio of Medición, Imus. The flow is approximately 100 gallons per minute, the water rising 18 feet in the standpipe.

Good wells have been finished in Binakayan, Imus, and Kawit. The rig is now in Dasmariñas.

#### CEBU.

The subgrade contract between kilometers 63 and 68 has been completed and a new section let. The road is now in excellent condition and passable at all times to station 68.500. Some ₱90,000 is needed in addition to the money now on hand to complete the subgrade to Bogo, the northern terminus of the road. It is not anticipated that

any such sum will be forthcoming until after the first of the year, hence it is quite possible that all construction work on this job will terminate shortly.

The Toledo-North Road subgrade contract is finished, making the road passable to the town of Tuburan, 96 kilometers from Cebu.



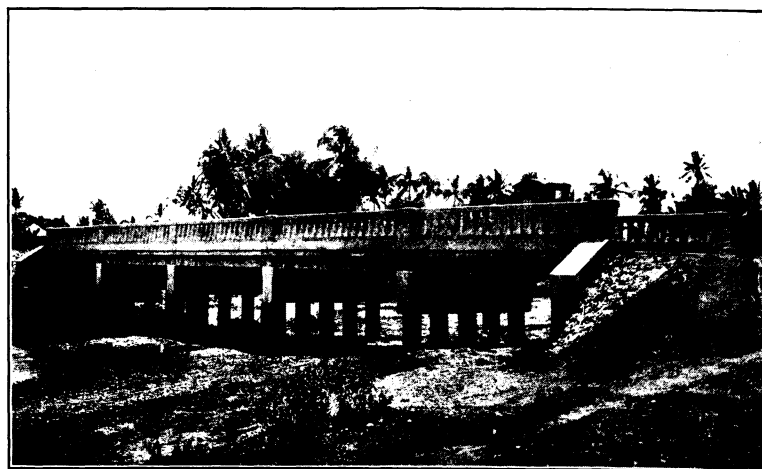
Municipal building at Mactan, Cebu Province.

For about 3 kilometers between kilometers 79 and 81 the bed of the Guinabasan River is used as the road, the subgrade alongside the river never having been built on account of lack of funds. A few soft sand bars make progress difficult at times, but a reasonable speed can be maintained by an automobile for the greater part of the distance.

Subgrade work south of Barili has been stopped, a fairly good section of old Spanish road having been reached. Surfacing operations are still in progress.

The construction of a reinforced-concrete disinfecting building at Cebu quarantine station has been in progress for the past two months. It is a 1-story structure with a tile roof, the plans having been prepared under the supervision of the chief quarantine officer. It was advertised, the lowest bid received being ₱13,000. The money available after deducting surcharges is ₱9,188, hence the district engineer has been asked to proceed by administration.

Schoolhouse construction is about finished. The Pinamungahan, Aloguinsan, Tuburan, and Toledo schools are all finished, having been built by contract. The contractors, Messrs. Kipp & York, finished the last building just four months after starting the first one. They were the successful bidders on the Cebu Primary School, Plan No. 20, their price being ₱47,980 for the building complete with concrete partitions and ingot-iron roofing. They also agree to complete the building in 120 days so that it can be occupied before January 1, 1915.



Danao Bridge, Cebu Province.

The work on the Inagayan River control was started in August and afterward temporarily suspended for three weeks. It is now proceeding nicely and should be finished in fifteen days. It consists of the excavation of a channel 15 meters wide at the bottom, with side slopes of 1.3, and the construction of two parallel dykes, one on either side of the channel. A 15-meter berm is left between the

toe of the inner slope of each embankment and the top of the channel cut. The excavated material is used in the dyke construction, the average haul being above 20 meters. The work is being done by contract at ₱0.395 per cubic meter.

#### ILOCOS NORTE.

The construction of the Laoag-San Nicolas Road between station 1+260, the south end of the Laoag River spillway, and station 2+900 has been completed satisfactorily by the contractor, Señor Daniel Galza. It was found that by relocation the road could be straightened considerably, and at the same time shortened 100 meters, but the probable excessive cost of right of way seemed to prohibit the relocation, especially as the project is small. However, it was figured that ₱35 per annum would be saved on maintenance by adopting the shorter location, which sum, capitalized at 4 per cent, would justify the expenditure of ₱875 additional in order to build on the shorter location, and the relocation was made. The contractor agreed to the change without augmenting his contract price, and by trading the old location for the new in the majority of cases the right of way actually cost a great deal less than ₱875. The project, waterbound gravel surfacing, with two short sections asphalted, cost ₱8,893.91.

The Bacarra School has been completed all but ceiling and concrete partitions, at which point work was suspended due to lack of funds at the time. The school is now occupied, but additional funds have since been received, probably sufficient to complete the partitions during the Christmas holidays.

Work on the Batac market has been held up considerably on account of the slow delivery of lumber and the recent baguio. The columns are all finished.

The Laoag market has been laid out and the contractor, Señor Galza, is getting ready to grade the site.

Work on the reconstruction of San Miguel School, an old Spanish type of building, is more than half finished.

#### ILOCOS SUR.

Kilometers 6 and 7 on the Bangued-Peñarrubia Road have been completed and the municipality of Bangued is now connected with the township of Peñarrubia. The road is 7 kilometers long. The metaled section is built 2.50 meters wide with 1-meter shoulders, on a 15-meter right of way. Total cost of entire road is ₱11,413.49, including all surcharges. The road has been accepted by the provincial board and is now open to traffic.

Kilometer 55 within the city limits of Candon on the Manila-North Road has been completed at a cost of ₱4,901.83, including all surcharges. With the completion of this kilometer the Province of Ilocos Sur has a section of first-class road 65 kilometers long, including all municipal roads with no breaks except at large rivers.

Kilometer 22, together with 800 meters on kilometer 23 on the Manila-North Road through the municipality of Lapog, has been completed. This section is a diversion from the old location, and was constructed in accordance with the standard cross section approved by the Bureau of Public Works for this locality, with a metaled section 4.27 meters in width and 1-meter shoulders. Width of right of way, 15 meters. A concrete overflow section 20 meters in length has been placed, and during the recent floods it proved to be all right.

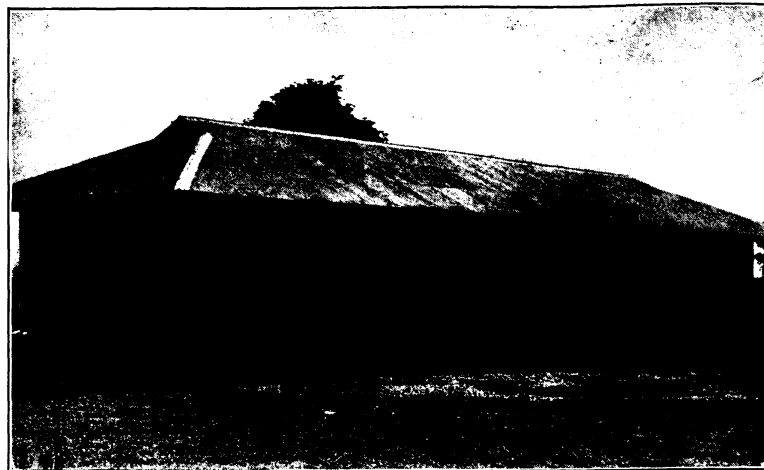
Plans for the Santa Cruz diversion road between the municipality of Santa Lucia and the barrio of Sevilla have been approved by the Director of Public Works, and nearly 2 kilometers of subgrade have been completed. This section of road is 13.48 kilometers long and traverses a rich sugar, rice, coconut, and tobacco country. The location is east of the present old road and on higher ground.

On this location the Santa Cruz River can be bridged with a total span of 280 meters. Its banks are straight and fixed except that the south bank shows a little scour. The bridge location on the present old road needs a bridge of about 780 meters total span, and, moreover, the bed of the stream is uncertain and shows considerable scour on both banks. The new location will pass about 800 meters east of the town of Santa Cruz, which is in danger of being washed away.

Work has been started on kilometer 66 on the Manila-North Road between the municipalities of Candon and Santa Lucia, and will be continued until the latter is reached (kilometer 71). That is, if funds are made available to do so.

The standard 4-room school building situated in the municipality of Bantay has been completed. Work was commenced on April 29, 1914, and completed on September 15, 1914. Cost, ₱9,503.38, including surcharges. Of this amount ₱104.76 was expended in putting in spread footings of concrete at the east end of the building, where a very poor class of soil was encountered.

The Cabugao, Lapog, and Bical bridges have been completed in accordance with revised plans, and two of them have been opened to traffic. The Bical Bridge will be opened to traffic as soon as the 2,000 cubic meter fill at the south approach can be completed.



Bantay School, Ilocos Sur Province.

#### ILOILO.

The cost of regular maintenance throughout the province during the last quarter greatly exceeded that for any previous similar period on account of the heavy rains and typhoons experienced. None of the latter were severe, but the rain has been practically continuous. The last 5 kilometers on the Iloilo-Zarraga Road were completely inundated, and it will require considerable work to put this road again into first-class condition. The Iloilo-Santa Barbara and Iloilo-San Joaquin Roads also suffered somewhat, one large wooden bridge and several kilometers of road being washed out on the latter. The bridge has been repaired, but the roads can not be put into shape until after the rainy season. The first 5 kilometers of the Santa Barbara Road have been resurfaced, also kilometers 8 and 9 of the same road. The ferries at Tagbayan and Cabatuan were lost, but have been replaced.

The nursery work continues very steadily and successfully. Of the 337 cuttings and slips obtained from Manila none have been lost. A small coconut nursery has also been started. Some 200 plants have sprouted already and have been transplanted on the Molo-Jaro Road.

The Panay auto line continues operations from Pototan to Janiway and from Pototan to Barotac Nuevo. Since the recent floating of the deck of the collapsible bridge over the Jalaur River, however, the service has stopped at the river, as the provincial board has requested that the deck be not replaced until after the present rainy season. One of the Hewitt trucks will be placed on the Barotac Nuevo side of the river, the transfer of passengers and freight being handled by ferry.

With the completion of the river wall and back fill for same, all port works have practically stopped. The small balance remaining will permit the completion of the roadway on and leading to the new wall. A portion of the old Spanish river wall between the two new sections was undermined by the heavy rains and flood tides of July, and turned over into the river. Piles were immediately driven to prevent any further slipping, and the danger to the new work is temporarily eliminated. It will be necessary to replace the old section of the wall entirely.

Plans have been prepared and the contract is soon to be let for the reconstruction of a school building in the municipality of Janiway. The present building is a very dilapidated structure of native stone with an iron roof. The work of reconstruction will consist of a new roof and trusses, a new floor, new ceiling, new doors, windows, and partitions. It will also be necessary to point up the walls and door casings.

Calles Real and Iznart in the poblacion of Iloilo are being resurfaced and put in first-class condition. The rock used is a fine-grained black basalt, which is remarkable for its durability, but is low in cementation value. This lack is overcome, however, by mixing limestone screenings with the top course. This binder gives such excellent results that roads built in this manner need the minimum maintenance even under heavy traffic.

Calle Blumentritt is nearing completion. This street, in the heart of the shipping district of Iloilo, is a decided improvement and will facilitate transportation immensely. The street is 17 meters wide with concrete curb and gutters and a 2-meter concrete sidewalk on either side. Considerable difficulty was experienced at first in getting

a satisfactory subgrade as the roadway is on a hydraulic fill, but at present the street is in first-class shape with no evidence of sinking.

A new street built from La Paz Bridge to the ice plant and Standard Oil bodega is now nearing completion. The road is about 900 meters long and 6 meters wide throughout. A timber bridge on piles, 20 meters long and 6 meters wide, also built by administration, was a feature of the project. This road was a very expensive piece of construction, having been built on a fill through a swamp. A great part of the fill is of rock.

A contract has been let to W. H. Lambert & Co. for furnishing and placing rock in the construction of a jetty for the protection of the beach and road at Molo. This jetty is to be one of two and is to extend 470 meters out to sea from the foot of Calle Antigua. It will have a top width of from 1 meter to 1 meter 60 centimeters, and is so located as to reclaim about 250 hectares of beach land by holding tidal and current deposits. Ultimately a dike similar to the Cavite Boulevard will be constructed along the inside of the jetty. This is a much-needed improvement and is an absolute necessity. The Molo River is eating into the shore very rapidly, so rapidly, indeed, that in another year the coast road is liable to be washed out.

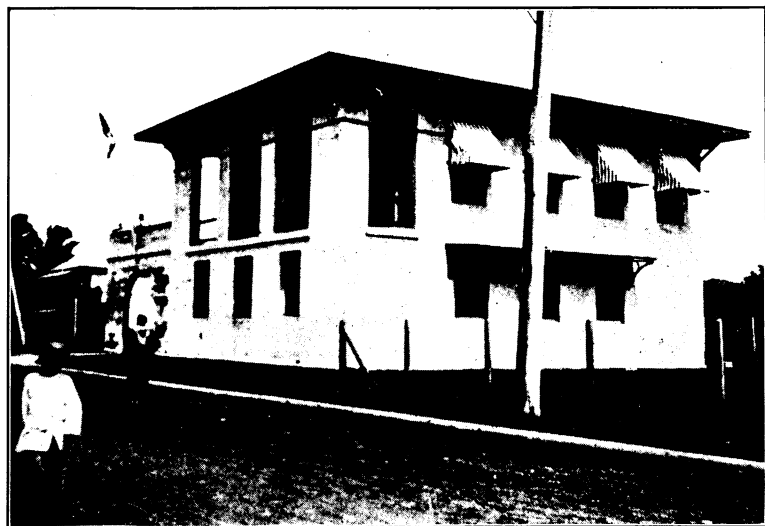
The appearance of the provincial grounds improves daily, due to the constant attention of the gardener in charge of the nursery. The various walks have been laid out and the shrubbery planted. It is hoped to secure sufficient funds at an early date to complete the concrete curb and sidewalk around same.

Work on the San Miguel-Leon Road has been practically stopped on account of the rains. The two culverts under contract with O'Leary & Burns were completed within the contract time, however.

In connection with the construction of the weir over the Molo River, it was found necessary to build a small permanent powder house on Guimaras Island. This was built of adobe stone and mortar with a sealed galvanized-iron roof and door. The floor was laid with adobe stone and mortar.

Bridge 17.3 on the Iloilo-San Joaquin Road has been completed and opened to traffic. The contract was let to A. Buchanan, who also constructed bridge 15.5 on the same road. Both bridges are of the same type, the former being two 8-meter slab and girder spans on concrete piles and the latter three 7-meter slab and girder spans. The work is excellent in both cases.

The Dueñas-Lambunao Road is gradually being worked into condition. The full appropriation has not yet been received, and the shortage of funds has made the handling of a small force necessary. The first and second gravel courses are rolled as far as kilometer 10, and the final course as far as kilometer 8.5. The appropriation is practically exhausted, but a maintenance force will be kept on until additional funds are received.



Constabulary headquarters building, Iloilo.

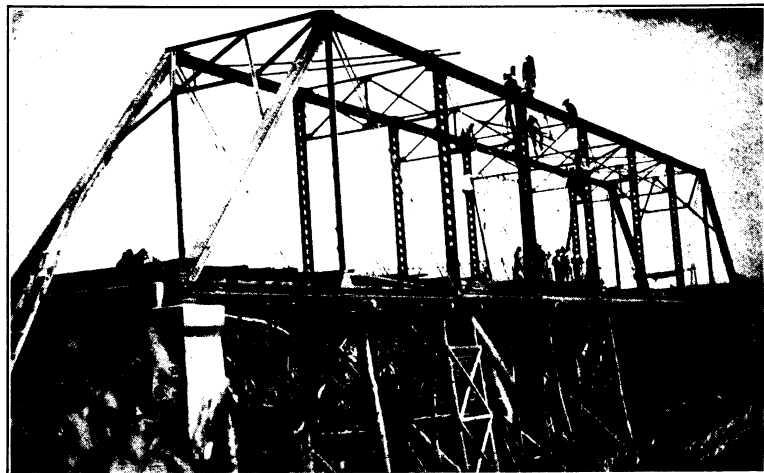
Work on the Lucena-Jalaur Road has again been organized and the surfacing of same will be started immediately. Gravel will be purchased from the railway company, no other material being available. The first 4 kilometers will be handled by tramway from the station, the last 4 by a "paquiao" contract.

Surveys have been made for bridges over the Assisig River between Passi and San Enrique, and over the Lamonon River between Passi and Calinog. A survey has also been completed for a bridge over the Suague River between Pototan and Dingle.

Locations for market sites in Estancia and Sara have been surveyed. Most of the funds are already provided and it is hoped to begin construction at an early date.

#### ISABELA.

Public works in this province, with the exception of Cordon-San Luis Road, Rugao Bridge, maintenance of first and second-class roads, and Constabulary barracks, have been discontinued since the beginning of September due to lack of funds. But little tobacco has been marketed yet, consequently land taxes due and expected in the August, September, and October collections from the tobacco farmers are most uncertain.



Rugao Bridge, Ilagan-North Boundary Road, Isabela Province.

The Rugao Bridge is almost completed and will be dedicated October 3, 1914. It was swung September 8, but on account of Manila riveters getting sick for two weeks, the riveting has been delayed. With the completion of this bridge the Province of Isabela has achieved one of its biggest works for years, for the common mind has always thought that it would never be finished. Great difficulties have been encountered during its construction, but modern methods have overcome them with success. This bridge is a 160-foot steel span supported by concrete piers. The bottom of the stringer is 10 meters above low water and 94 centimeters above the highest known water. An additional 24-foot I-beam span forms the approach at each end of the main span. The floor is of ipil on 14-foot roadway.

Grading on the Cordon-San Luis Road is almost completed from Ilut to San Luis (northern boundary of Nueva Vizcaya). The heaviest work is already done. Timber for the temporary bridge on Ilut Creek is being hauled over to the site and construction will soon be started.

The concrete work on the Constabulary barracks at Ilagan is completed with the exception of the floor and steps. Some of the trusses are already in place. It is expected that the building can be occupied some time in November.

On the San Pablo-North Boundary Road, 1 kilometer out of San Pablo is already completed at a cost of ₱3,635.38, including surcharges. The work is being discontinued due to lack of funds.

The provincial board, at the request of the district engineer, has ordered the municipalities to have all reconstruction work on the streets (in the towns near the river) leading from the river landings toward the main road, done under the supervision of the latter. In this way proper grading, surfacing, and rights of way can be obtained, so that in the future no changes will be necessary. On this basis the town of Reina Mercedes is actually building her streets and river landing. An effort will be made to have all the towns appropriate enough money for the improvement of their main streets and river landings. Tumauni has already signified her good intention toward this end.

Repairs on the Provincial High School will be made as soon as the lumber arrives. On the provincial grounds at the east side of the provincial building a concrete water-closet is almost completed. It is designed at present for the pail system until more money is available, and then it will be fitted with sanitary plumbing. The provincial storeroom is to be removed to the grounds adjoining the jail, and two concrete tanks with capacity of 2,000 gallons each for fire protection, etc., are to be constructed.

The survey of the road from Ilagan to Angadanan is in progress, also the investigation and survey of Upi Creek midway between Ilagan and Naguilian. This is done in order to have plans ready when money at any time becomes available, so that construction will not be delayed.

## LAGUNA.

The baguio of the first part of September did considerable damage to the roads in various localities, but no serious damage anywhere. The greatest damage was sustained by the Manila-South Road from Biñan (kilometer 35), to Los Baños (kilometer 65). One of the temporary bridges on the Calamba-Canlubang Road was damaged sufficiently to close the road for three days before the bridge could be repaired.

Work on the San Pablo-Nagcarlan road was suspended on August 31, owing to the exhaustion of funds, 6.7 kilometers having been completed. The section completed included the worst parts of the road, which is now open for wheeled traffic throughout its length. It is hoped that other funds may be provided for the continuance of this road, for the traffic which has developed since these 6.7 kilometers have been completed indicates that this road will have the heaviest traffic of any road in the province.

The resurfacing of kilometers 4 to 7, inclusive, of the Santa Cruz-Magdalena Road was begun during the latter part of August, but has been delayed greatly by the incessant rains. Approximately 1.5 kilometers will be completed by September 30.

Notwithstanding the unusually heavy rains, the second-class roads from Calamba to Vigaa, from the end of the new work east of San Pablo, by way of Nagcarlan and Lilio, to Maimpis on the Magdalena-Majayjay Road, and from Lumban to Mavitac are still open to wheeled traffic and in fair condition.

The high school building at Santa Cruz is nearly completed and should be finished, with the exception of the painting, by October 15. There will not be funds available for the painting until next year. This is a standard 20-room Bureau of Education plan schoolhouse, less the four rear rooms, but has concrete partitions throughout instead of wooden as shown in the plans. Using manganese oxide for coloring matter, excellent blackboards were made on the concrete partition walls at very small cost.

Work on the José Rizal Memorial School Building at Calamba is progressing favorably and it is expected that it will be ready for dedication on December 30. One wing is entirely completed, the front and assembly hall are very nearly completed except the tower, and the other wing is ready for the roof.

A Bureau of Education No. 7 schoolhouse is under construction by administration at Lilio, and should be completed in October. The cost of construction has been higher than usual, both on account of the high cost of sand and gravel and the necessity of transporting the building materials for a long distance and over bad roads.

The No. 5 schoolhouse at Calauan has had its ceiling completed, the steps, windows, and doors repaired, and all the woodwork except the doors painted, the doors being hard oiled.

Work consisting of minor alterations and repairs is under way on the Siniloan Schoolhouse, an old Spanish structure remodeled.

Plans for the San Pablo Domestic Science Building are very nearly completed and construction is expected to begin shortly. This will be a 5-room semipermanent structure 12.30 by 18.30 meters, and will be constructed with municipal school funds. Estimated cost, ₱4,000.

The sum of ₱5,000 has been allotted from Gabaldon funds for the alteration and repair of the Biñan Schoolhouse. This is the old hacienda building of the Biñan friar estate, and, while large and full of rooms, is not very well suited for school purposes on account of the arrangement of the rooms and their poor lighting. The money will be expended in remedying these defects, the work to be started early in October, as soon as the high school is finished. Like all other construction now under way in the province, it will be done by administration.

The division superintendent of schools has advised this office that there are funds available for a Bureau of Education plan No. 2 schoolhouse in the barrio of Santísimo Rosario, San Pablo, and for a No. 3 schoolhouse at San Pedro, and desires that work on the latter be started as soon as possible. Funds are also available for the repair, alteration, or painting of several other schoolhouses throughout the province, though the work to be done on any particular building will not be of much extent.

The physical laboratory being constructed at the College of Agriculture, University of the Philippines, near Los Baños, is very nearly completed, and should be ready for occupancy by October 15. Owing to the largely increased attendance at the college this year the classes have been considerably crowded, but with the completion of this building with its three large classrooms such conditions will no longer exist.

The San Pablo market and a group of six tiendas will be completed and turned over to the municipality about October 1. The market, 30.0 by 43.5 meters, is of the San Roque type with galvanized-iron roof, and the tiendas are of the latest type single tiendas with plain galvanized-iron roofs. The cost, including considerable grading and

the surfacing with stone of the earth adjacent to the market and tiendas, approximates ₱28,500.

Contract for the material for the San Pablo waterworks was let to the Atlantic, Gulf and Pacific Company on August 8, 1914, in the sum of ₱57,017.775 while the installation will be done by administration. Work on the project was begun September 15, and the gate-house at the spring will be completed during October.

Lack of funds has prevented further action regarding the steel-truss bridge which was planned for Pagsanjan, and also for the reinforced-concrete arch across the San Cristobal River at Calamba to replace the steel truss which was washed out in 1912.

The output of the Los Baños quarry for the quarter ending June 30, was 7,417.30 cubic meters, yielding an income of ₱16,150.86, while that for the quarter ending September 30, was 6,100.50 cubic meters, yielding an income of ₱13,421. The output of the quarry to date, September 30, 1914, has been 78,128.05 cubic meters, which, sold at various prices, has yielded an income of ₱237,774.49.

## LA UNION.

An interesting example of the effect of retarding the flow in a river carrying considerable silt and sand was afforded by the Bauang River during the rainy season just past. This river passes through low, sandy land, close to the seashore, and has cut for itself a bed about 1 kilometer wide at the point where the first-class road crosses it. During a flood the water spreads itself all over the river bed, but at subsidence it confines itself to one, or at most two, channels. The bottom of the shifting sand is about 1.5 meters deep and is underlaid with a stratum of gravel to an unknown depth. For the past two years the water channel has confined itself approximately to the center of the river bed, which was spanned by a collapsible pile-bent bridge 300 feet long. During the present rainy season the resistance of the piles to the current caused the deposition of a sand bar just below the bridge, which extended upstream for 200 or 300 meters from the bridge, and increased in depth until the bridge itself was covered with sand to a depth of 30 centimeters throughout its entire length, forming the highest ground anywhere between the north and south banks at this point. The water in the river meanwhile cut itself a different channel through the sand along the extreme north bank, and another smaller channel along the extreme south bank; the latter, however, runs dry at low water stage.

To make provision for the uncertainty of the channel remaining where it is at present, movable trestles are now being made to support the collapsible bridge, taking the place of the pile bents, so that, no matter where the river channel may establish itself, there the bridge may be placed also and anchored.

On August 2 ground was broken for the construction of the 16-room reinforced-concrete school building (Bureau of Education plan No. 20) at San Fernando. The construction is being pushed along steadily, and at present writing all column footings have been poured, and the columns and beams started. This schoolhouse occupies a beautiful site just at the eastern edge of San Fernando, and about 300 meters southeast of the proposed site for the Manila Railroad Company's San Fernando station.

Various small contiguous plots of land in Bauang are now being purchased by the municipality to form a site for the proposed new reinforced concrete market building to be built.

Work on the San Fernando market is being pushed steadily ahead. All columns are erected, all lean-to rafters and hip rafters are in place, and trusses are being placed. The earth fill to support the floor was put in by "paquiao" at ₱0.40 per cubic meter, the measurement being of earth in place and compacted.

## LEYTE.

The last of the six Contra Costa bridges, Pamipian (2 spans of 6 meters each) and Binabulan (2 spans of 7 meters each), have been completed by administration at costs of ₱4,429.35 and ₱5,667.96, respectively. A résumé of the results obtained on these six bridges shows that their total cost was ₱40,775.59. The total estimate was ₱52,400, and the lowest bid was ₱55,850. With surcharges and an inspector, at ₱140 per month, the total contract cost would have been ₱63,053, which shows that a saving of 35 per cent was made by doing this work by administration.

As an illustration of the benefits derived from a permanent organization devoting itself exclusively to one type of construction, it might be of interest to note that the first pile bridge constructed in Leyte (June, 1913) cost slightly over ₱400 per linear meter. The same foreman and gang built the next pile bridges and reduced the cost to ₱390 per linear meter, including surcharges. Later, when the same organization, practically intact, was transferred to the Contra Costa work, the cost per linear meter was reduced to ₱343, including surcharges. From data obtained on some of these bridges it was noted that piles cost approximately ₱45 per cubic meter, in-



cluding form lumber. The average cost of driving at the first bridge was ₱2.12 per linear meter. This cost has since been reduced to an average of ₱1.75 or better, depending upon class of material encountered.

In view of the article in the last issue of the QUARTERLY BULLETIN on concrete piles, it may be of interest to note that the results observed on the construction of these Contra Costa bridges practically checks all the observations of the writer of that article, especially in regard to equipment. A 2,000-pound hammer was used, and it was noted that some piles were shattered as much as 70 centimeters, which could have been avoided with a larger hammer. A 6 by 5 by 6 inch force pump with 4 inch suction and 3 inch discharge was used, but it was found to be too small. A 16-horsepower boiler and hoisting engine was used. This is the minimum size permissible, and would probably be too small if a larger hammer and pump were used. The piles were in all cases driven to an almost perfect alignment. This was accomplished by laying a frame work of 6-inch timbers near the ground and another near the bottom of the driver, both branches being securely braced. The resulting squares, 42 by 42 centimeters, through which the piles are driven, allow the pile but 2 centimeter play on each side.

In driving the piles four iron fishplates, each 3 feet by  $\frac{1}{2}$  by 4 inches, were bolted to the follower by two  $\frac{1}{2}$ -inch bolts each. The ends of these plates were turned up and bent to fit into an iron collar bolted around the top of the pile. This keeps the follower and cushion in place fairly well, but is probably inferior to the method advocated by Mr. Harrison. A cushion of pieces of  $1\frac{1}{4}$  inch rope coiled and fastened together with bejuco or wire and piled to a depth of 18 inches gave fair results. At first the cushion was made of rope and the rubber of worn out automobile and motorcycle tires, and this gave good results as long as the supply of old tires held out. Ipil, molave, and dungon were tried for followers, the dungon giving by far the best results.

The engine and boiler were placed on the bank separate from the pile driver, and thus permitted the moving of the driver with less work, cost, and time than if the weight of the engine and boiler had to be moved. The power plant remained at one location during the construction of each bridge, the cable being led by snatch blocks so as to obtain a direct pull.

During the past quarter the construction of the Palo-South Road did not proceed as expeditiously as was expected from results obtained during the preceding months. Unseasonable rains were the principal cause of the failure to maintain the same rate of progress; contributory causes were the necessity of changing the base of tramway operations on account of the exhaustion of suitable material, the unusual amount of rolling needed to compact the stone, and the laying off of two rollers on account of worn-out piston rings. Only little over 2 $\frac{1}{2}$  kilometers of surfacing were laid as against nearly 5 kilometers for the preceding quarter, the metaling now being completed to kilometers 55.5. The supply of surfacing material having been exhausted from the different river deposits, crusher operations will be resumed, using stone from a ledge at the barrio of Calbasag about 1 kilometer north of Dulag.

The Guinarona School (standard plan No. 2) was completed by administration at an approximate net cost of ₱5,360. Estimated cost ₱5,300. This school is located 37 kilometers from Tacloban, and the transportation charges amounted to nearly ₱600.

Excavating for the Palo abutment of the Dapdap Bridge has been begun. This is a steel bridge of 80-foot span on concrete substructure supported by wooden piles. On account of the lowness of the water, some difficulty was experienced in obtaining gravel, which has to be obtained at a point 5 kilometers upstream. This was overcome by damming the stream sufficiently to raise the water about a meter, which permits the men to float their barotos loaded to the water's edge with gravel. The work is being done by administration.

The Atlantic, Gulf and Pacific Company has been awarded the contract to furnish steel for the superstructure of the Mainit Bridge (two 120-foot spans) at a cost of ₱12,500. The work on this project will not commence until after the rainy season, which ends here about the middle of January.

The new provincial bodega is practically completed at a cost of about ₱700 more than the estimate. This difference is caused by the fact that the estimate, which was made over a year ago, contemplated using Apollo roofing, while in the actual construction the more costly but more durable Three Crown roofing was used. Work was done by administration.

As no bids were received for the Capocan School (standard plan No. 2) and the Consolacion School (standard plan No. 3) the work will be done by administration. Material has been requisitioned and construction will start as soon as it arrives and the organization now at work on the Palo School can be transferred. The estimates for these schools are ₱5,621 for Capocan and ₱8,833 for Consolacion.

The Baybay market (43.5 by 21 meters) has been completed by administration at a cost of ₱16,502.45, divided as follows:

Material .....	₱9,313.62
Labor, including grading .....	4,096.27
Supervision .....	453.83
Miscellaneous .....	1,144.10
Net surcharge .....	1,494.63
Total .....	16,502.45

The estimate for this work figured on same basis as above was ₱17,958.53. With this saving, and the ₱4,000 additional which the municipality has appropriated, the construction of a block of 4 by 4 tiendas will shortly be undertaken.

Work has been commenced on the Palo School (standard plan No. 7) by administration. The lowest bid received was about ₱500 in excess of the estimate, which is ₱14,100 exclusive of all surcharges.

Active construction has just been commenced on the Palo market. All the material except some framing lumber has been received and barring accident this project should be pushed to as successful a conclusion as the Baybay market. The same foreman and men are being employed and they should profit by their experience on the Baybay job and obtain even more economical results in this instance.

Three balsas, each capable of sustaining the weight of a pony and carromata, are being built for the Matalom, Sargosa, and Hilongos Rivers at kilometers 28, 30, and 36, respectively of the Maasin-Inopacan Road. The work of reducing grades and generally improving this road is progressing satisfactorily as is also the reconstruction of the Macrohon-Maasin Road.



Kilometer 26, Tacloban-Carigara Road, Leyte Province—a part of the system that won a prize.

Automobiles are proving an important factor in the development of the province. They have practically superseded the carabao in the hemp transportation business which permits the latter to be used for work in the fields, resulting in a larger area of cultivation.

The Leyte Land Transportation Company have increased their equipment during the last quarter by the purchase of one 2-ton Packard truck, one long chassis 25-passenger aluminum body  $1\frac{1}{2}$ -ton White, one  $\frac{3}{4}$ -ton White, and three Troy trailers of 3 to 5 tons capacity each. They have ordered a Knox 10-ton tractor and a 60-horsepower, 6-cylinder, 3-ton White truck. Their equipment now consists of five White trucks, one 25-passenger White, four Gramm 2-ton trucks, two Rapid trucks, one Packard, three Troy trailers, one 7-passenger Chalmers, one 5-passenger Hupmobile, and three 5-passenger Buicks. They have also completed a concrete and galvanized-iron garage 70 by 100 feet with room for 30 cars, in addition to a concrete bodega 22 by 32 feet used as a storeroom for gasoline and petroleum.

The La Union Company, recently organized, has started in the transportation business with an equipment consisting of three new Delahaye trucks, two of which are 2 $\frac{1}{2}$  tons capacity and the other 3 $\frac{1}{2}$  to 4 tons capacity. As soon as business permits they intend increasing their equipment by the addition of 3 more trucks of from 2 $\frac{1}{2}$  to 3 tons capacity and to construct a semipermanent garage.

#### MANILA.

The principal item connected with the work under the supervision of the office of the structural engineer has been the completion of the girls' dormitory on Taft Avenue at an approximate cost of ₱300,000. This building was commenced on January 4, 1913. The contract for driving piles under this building was awarded to the

Atlantic, Gulf and Pacific Company on January 4, 1913. The contract for the construction of the building proper was awarded to Mr. S. C. Choy, contractor of Manila, while the electrical installation was given to German & Co., electrical contractors, also of Manila.

The building has been finished twenty-one days ahead of contract time and the electrical installation completed some thirty days ahead of time.

The maintenance, alteration, and repair of Insular buildings during the three months under review has cost approximately ₱18,781.

A small pier has been constructed for the Insular Purchasing Agent between Piers 3 and 5 at an approximate cost of ₱2,000.

The work of dredging has been continuous during the period covered by these notes and consists principally of the following operations:

The seagoing suction dredge has worked in the outer harbor, the Pasig River bar, and the inner basin in the vicinity of the Earnshaw slipways.

Ladder bucket dredge No. 2 is steadily working on the Pasig River toward the Bridge of Spain.

Dredge No. 1, which had been working in the inner basin, was laid up on August 15, partly on account of diminishing funds available for the present fiscal year and partly to undergo her annual overhaul.

Priestman dredge No. 5 is completing her work of dredging in Binondo Estero and during the remainder of the fiscal year will be dredging in the Estero Reina Regente toward the Escolta and the Pasig River.

Dipper dredge No. 6 is engaged in dredging the Estero Balete between Taft Avenue and the electric-light works. The material dredged by this machine is taken to the campus of the Philippine University. The approximate cost is 32 centavos for dredging and 65 centavos for transportation, making a total net cost of 97 centavos per cubic meter in place, in comparison with the lowest bid received when the work was advertised of ₱1.64 per cubic meter.

The lighthouse repairs carried out during July, August, and September consist of the completion of the new light station at Balabac, repairs to the wharf and repairs to such old buildings at Balabac station as it was deemed economical to preserve.

The thorough overhauling of the Maniguin light station off the northeast coast of Panay will be completed in the early part of November at an approximate cost of ₱6,000.

Minor repairs have been made at Cape Engaño, Cape Bolinao, Sangley Point, and the Pasig River lighthouse.

#### MISAMIS.

Figure 1 shows the public fountain recently completed by the municipality of Mambajao, Camiguin Island. The water has not yet been turned on. The effect of this fountain when approaching Mambajao from the sea is very striking.

Work on the Mambajao Central School building has been suspended owing to lack of funds. This is a standard plan No. 14, 98 per cent completed. The Agoho Barrio School building has been recently completed.

The road from Mambajao to Mahinog, a distance of 14 kilometers, is being reconstructed. Kilometers 10, 11, 12, 13, and 14 were impassable in the rainy season prior to the starting of this work. These kilometers are now completed with the standard cross section for a first-class road, but the traffic and available funds did not justify a standard first-class surfacing, hence a surfacing of gravel 7 centimeters deep and 3 meters wide was placed and well rolled. The rest of this road was second class but in poor repair, hence it was decided to reconstruct the entire road in the manner described above. Kilometer 1 is now completed, and the subgrade is 500 meters in advance. A bull train owned by the province supplies the surfacing material, and an 8-ton roller is used.

A 7-centimeter course of gravel has been placed on the Cagayan-Tagaloan Road between kilometers 3 and 11, inclusive, and rolled with a 10-ton roller. This is a first-class road which is beginning to show wear to quite an extent. This section was constructed in 1909.

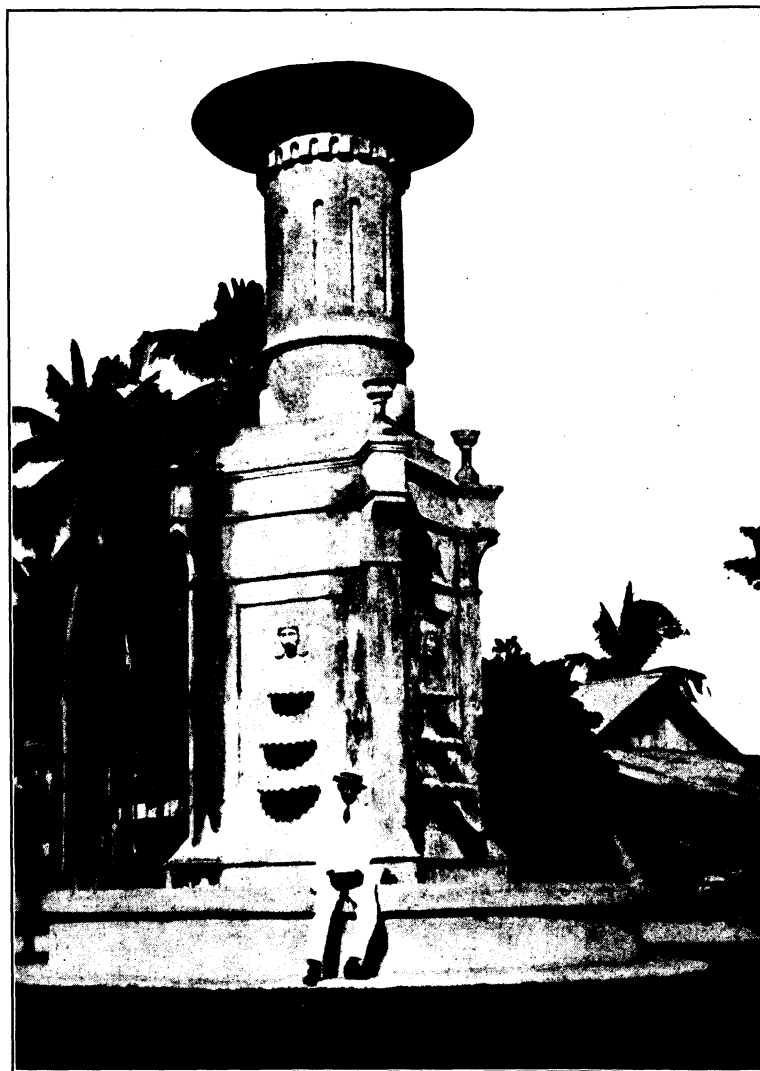
The construction of the Iponan collapsible-deck bridge on the Cagayan-West Road is now under way, all material is on the ground, and two bents of piling are in. The grading of this road is completed for 17 kilometers, or within 4 kilometers of El Salvador.

#### NUEVA ECIJA.

The contract for the Bureau of Education standard plan No. 2 school building, barrio of Papaya, municipality of Peñaranda was let to Mr. E. G. Clark, a local contractor, for the sum of ₱5,800 on July 16, 1914. The construction of this building is now about 80 per cent completed.

A standard No. 5 school building has been completed in the municipality of Jaen and turned over to the Bureau of Education.

Material for an academic building at the Central Agricultural School has been received, and construction will be pushed as rapidly as possible.



Public fountain, Mambajao, Misamis.

Funds have been received for the construction of a market in the municipality of Cabanatuan, and work for this building will be advertised by October 15.



Correcting a reversed grade and curve, Mambajao-Agoho Road, Misamis Province.

Two artesian wells have been completed in the municipality of Cuyapo, and Bureau of Public Works rig No. 19 is now working on a third. Excellent artesian water, with a flow of 40 gallons per minute, is obtainable in Cuyapo at a depth of 350 to 400 feet.



Bureau of Public Works rig No. 17 has just completed a well in the municipality of Cabanatuan with a flow of 30 gallons per minute at a depth of 570 feet. As soon as this rig has finished in Cabanatuan it will move to the municipality of Gapan and as soon as rig No. 19 has finished in Cuyapo it will move to the municipality of Nampicuan.

The success of the Bureau of Public Works in drilling artesian wells in this province has aroused the interest of many of the farmers, and several private rigs are now at work drilling artesian wells for irrigation purposes.

A loan of ₱40,000 has been received by the province for the construction of a bridge across the Talavera River to consist of two 160-foot steel spans. The Atlantic, Gulf and Pacific Company have been awarded the contract for the fabrication of the steel for this bridge at a cost of ₱0.175 per kilo. The piers and abutments will be advertised as soon as the plans are completed.

The heavy rains of August and September flooded all the rivers in this province, so that in many places the water was 1 meter deep on the first-class roads. No damage was done to any of the roads, however, except that the back fill of the Baliuag Bridge was washed away, causing a loss of about ₱500. The damage has all been repaired and the rivers are getting down to normal again.

The collapsible bridges at Cabanatuan and Gapan were out of commission during the months of August and September, owing to the unusual heavy rains which kept the rivers flooded at all times.

Work has been resumed on the Aliaga Road, and gravel is now being delivered on kilometers 8, 9, 10, and 11. It is expected to complete the work on this road by December 31, 1914.



Kilometer 56, Guimba-Pangasinan boundary section, Nueva Ecija Province.

Work on the San Isidro-Pampanga Boundary Road is progressing satisfactorily and the road has been finished to kilometer 12. Considerable objection has been made by the people living in the vicinity of Cabiao, on account of the subgrade being closed during the rainy season, but this was necessary in order to prevent the subgrade from being destroyed by traffic during the rainy season. The provincial board has passed a resolution declaring all roads in the Province of Nueva Ecija closed during construction. The hearty support of the board has greatly facilitated road construction in this province.

The road from Gapan to Peñaranda has been repaired and the whole distance is now a good second-class road.

Considerable work has been done during the last quarter on river control. The channels have been changed and straightened in the Talavera and Baliuag Rivers, and if proper care is taken in the future these rivers will cause no more trouble.

Grading on the Manila-North Road was greatly interfered with during this quarter by heavy rains, so that it was necessary to abandon the grading in the lowland sections. However, as the road passes through hilly country from Cuyapo to the Pangasinan boundary, grading was kept going on this section and is now completed, with the exception of 3 kilometers in the low section between kilometers 50 and 54. No surfacing has been placed during this quarter, but preparation has been completed for the delivery of gravel on October 1.

Acacia trees have been planted on all first-class roads in the province. In planting these trees, two experiments were made, first, taking trees from the nursery and planting them on the roads, and, second, preparing the ground and planting the seeds in the proper places on the road. The last method has proved the most satisfactory, and many trees that were planted in June are now 1.2 inches high. Trees that were transplanted are very delicate and about 20 per cent of

them died. Cuttings have also been tried, but this has been found to be a very poor way of getting a good growth of trees on the road.

Considerable work has been done during this quarter on the beautification of the provincial grounds. The province has received a large shipment of trees from the city of Manila, but with exception of the acacia trees, very few are living, hence it is proposed to use trees from the provincial nursery.

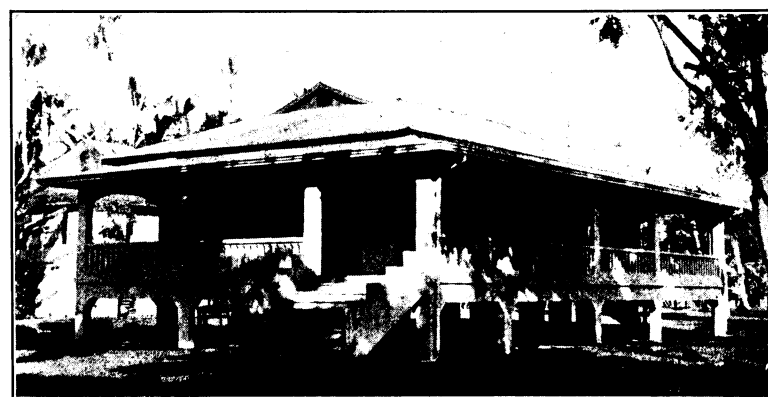
Seven hundred and fifty applications for water rights for irrigation purposes were received in this province during the last quarter, but owing to the lack of men it was impossible to investigate all the applications.

#### OCCIDENTAL NEGROS.

Excessive rains have caused the metaling work on the La Carlota-La Castellana Road to be delayed, but fairly rapid progress is now being made and the metaling should be completed as far as the Candaguit River crossing by November 1. The construction of the culverts on this section has been carried out by administration. The last of these, a 2-meter semicircular reinforced-concrete, 18 meters long with a 3-meter fill, is now being completed.

Work on the Hinigaran-Isabela Road has been shut down until a road roller is available for properly placing the metaling. It is proposed to use on this work the 12-ton roller recently rented from the Bureau of Public Works.

All of the reinforced-concrete culverts, seven in number, on the Alicante-Victorias Road have been completed, the work having been carried out by administration. Plans have been completed for the four bridges on this section. The specifications and advertisements are now being prepared.



Domestic Science School, Bacolod, Occidental Negros.

The Binalbagan Central School was completed and turned over to the municipality on July 28, the construction having been carried out by administration.

The Domestic Science School building at Bacolod, a reinforced-concrete structure 11.20 by 17.50 meters, the contract for which was awarded W. H. Lambert & Co., was completed and turned over to the local authorities on July 24. The building is provided with a complete plumbing system and with a septic vault. The contract price was ₱8,515, and the total cost including surcharges was ₱10,209.10.

A new grand stand for the high school at Bacolod has been completed.

A 2-story reinforced-concrete vault for the provincial building at Bacolod was completed August 18, the work having been done by W. H. Lambert & Co., contractors, at a total cost, including surcharges, of ₱3,598.90.

Work on the Murcia Central School was started August 4, 1914, and the building will be completed about October 15. This is an administration project, with L. B. Puentevella in charge.

Contract has been awarded to W. H. Lambert & Co., of Iloilo, for the construction of the Hinigaran market building, size 18 by 38 meters. The contract price is ₱10,950, exclusive of filling and grading.

A provincial machinery inspector has recently been appointed whose duties will include general supervision over the maintenance of pumps throughout the province. A description of each well and pump is being made and the information tabulated. An employee in each municipality is being taught how to take care of the pumps and the municipality is required to keep on hand at all times such tools and extra parts as are necessary for the repair work, to the end that delay will not be caused by having to wait for parts to arrive from Manila, or even from the provincial capital.

## ORIENTAL NEGROS.

Tayasan School, a standard No. 3 building, was completed on August 6. The contract price for furnishing plant, sand, gravel, and labor was ₱2,635. Materials were furnished by the province.

It is expected that the 7-room school under construction at Guijulan will be completed during October. It is at present about 85 per cent finished.

Construction of a No. 7 school at Tanjay will be started about October 1. Funds available amount to ₱11,925.75 which, with a loan of ₱750 promised by the province, will be sufficient to inclose the building. Contract for an inclosed building with concrete porch partition, but omitting windows, has been let to C. V. Powers for ₱9,486.

The north abutment of Ocoy Bridge has been completed and back filled. False-work piles have been driven and capped to within 40 feet of the south abutment. The excavation for the south abutment is practically finished and the driving of foundation piles will be started about September 24.

A good deal of trouble was experienced in driving the sheet piling for the south cofferdam. Boulders from 6 to 18 inches in diameter were encountered about 4 feet below the water level and it was found to be impossible to drive the sheeting through them in advance of the excavation. This necessitated the placing of sills at intervals of less than 2 feet to keep the planking from springing.

Considerable water enters through this layer of boulders, but so far has been handled by a 5 by 4 centrifugal without difficulty.

The work of resurfacing kilometers 10, 11, 12, and 13 of the Dumaguete-North Road was started on August 12. To date 2 kilometers have been scarified and rolled at a total cost of approximately ₱1,360, including all materials and labor. About 225 cubic meters of coral "gaay" are being placed to the kilometer. No binder is used, as with the hard foundation enough of the coral crushes under the roller to form all the binder necessary.

The 15 by 39 meter market building at Bais was completed on August 8 by the contractor. Total cost was ₱12,013.69, including ₱423.11 for extra concrete and grading and ₱1,745.58 for surcharges and Insular aid.

Owing to lack of funds the drilling of artesian wells in this province has been suspended until the coming year. Two successful wells have been completed in Dumaguete and one each in Bacong, Dauin, and Zamboanguita.

Materials have been ordered for a 20 by 40 foot pier at Larena. This will be constructed by administration and will cost approximately ₱3,500.

On the Bais-Tanjay Road 7 kilometers of subgrade have been completed, leaving 2½ yet to be done. The old subgrade on the remaining 5 kilometers is in good shape, needing only to be shaped up and rolled.

Surfacing is now being placed on about 1 kilometer of the first course finished.

Construction and repair of several small culverts on this road will be started as soon as materials are on the ground.

Pipe for the Talingting-Siquijor waterworks has been laid and connected and is supplying the barrio with about 10 gallons of spring water per minute. The headworks will be completed within a few days. All labor and transportation of materials has been voluntary, the local expenses to date being less than ₱20 for the capataz in charge.

Work on two standard markets will soon be begun. One 18 by 38 meter building is to be erected in Guijulan and one 18 by 32 meters in Tanjay. Construction will be started by administration as soon as the materials arrive.

## PAMPANGA.

No new construction has been undertaken during the past quarter.

The twenty-one days of rain in August and September did considerable damage to the roads in this province. On the Angeles-Porac Road the Porac (south) abutment on bridge 5.5 was undermined by the force of the Pasig River and settled, throwing the steel truss up stream 75 centimeters. The bridge, however, did not leave the abutment and was jacked up to its proper elevation. The river flooded the country for about 500 meters and washed out the sandy roadbed for some distance from the bridge. The abutments were built by the military authorities and were considered unsafe for a concrete floor when the wooden truss was removed. Owing to lack of funds, a steel truss was placed on the old abutments after putting on a new bridge seat, so that if any settlement should occur the bridge could easily be jacked back to place. Bridge 7 was choked

by bamboos and by two large tree trunks breaking one of the concrete girders. The road was washed out on both sides of the bridge. The bridge is now clear and the stream is again in its natural course.

Ten kilometers of first-class road were under water, some to a depth of 4 to 5 feet. Three kilometers of surfacing and binder were washed from the road, most of which was recovered. The water not being very swift in low Pampanga did no damage to the low-crowned roads.

The Arnedo Dyke withstood the flood with little damage. Patrols were established by the district engineer, and these cooperated with the tenientes and presidentes along 40 kilometers of dyke. These patrols strengthened the dyke at weak points and repaired slides, but made no attempt to keep the water from crossing the lower parts of the dyke where no material damage would result. The Constabulary and local people built up the lower places about 30 centimeters.

The Angeles-Porac Road is being resurfaced. This road has a good base, built by the military government, but the surfacing soon ground into sand.

The Bacolor School, plan No. 10, was inaugurated under impressive ceremonies on July 15, 1914. Assistant Director Magee of the Bureau of Education was present to assist in the celebration.

Materials have been ordered for the construction of a plan No. 6 reinforced-concrete school building for Macabebe and a plan No. 10 (less the two back rooms) for Mexico. Both will be 50 centimeters higher than the plans call for and will have concrete partitions.

Grading and ballasting for the Arayat quarry siding has been completed and the province is now awaiting rails and ties from the Manila Railroad Company. As soon as completed, rock will be shipped to the San Fernando-Apalit section of the Manila-Tarlac Road.

Construction on the Manila-Tarlac Road will be commenced about October 15, 1914, weather permitting.

## PANGASINAN.

There are market buildings to be constructed in San Fabian, Binalonan, Mangaldan, Tayug, Rosales, and Urdaneta. Sufficient funds are on hand in each of the municipalities except Urdaneta. These buildings are to be constructed in accordance with standard plans.

Schoolhouses are to be constructed, from standard plans, in several municipalities during the coming dry season. There will be one 7-room at San Carlos, one 10-room at Alaminos, one 7-room at Bolinao, one 6-room at San Manuel, one 7-room at Umingan, and the addition of two rooms to the present 4-room building in Bautista. In addition to these buildings there are under contemplation a 7-room building in Villasis, a 2-room in Salasa, and a 2-room in Lingayen.

There have been completed recently a three-room building at Bayambang, a 7-room at Malasiqui, and the addition of two rooms to the Asingan building.

Schoolhouse construction is at present being carried on in the municipalities of Binmaley, Mangaldan, Pozorrubio, and Balungao.

The Manaoag and Bayambang presidencias have recently been thoroughly repaired.

The municipality of Urdaneta is constructing a ₱34,000 presidencia.

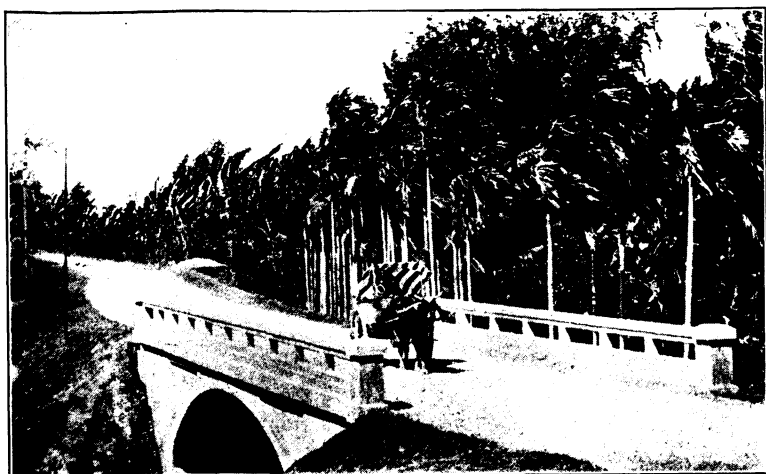
The municipality of Urbiztondo is contemplating the construction of a ₱16,000 presidencia.

The municipalities of Aguilar and Mangatarem have already appropriated funds for extensive repairs to their municipal buildings.

All construction work has been stopped on the Pangasinan section of the Manila-North Road on account of the heavy rains which have been occurring daily since July 1.

From August 25 to September 10 there have been very high floods throughout the lowlands. These floods have damaged the first and second-class roads very seriously. There has been very serious bank scouring at the sites of three collapsible bridges. In each case this scour was on that end of the bridge which abutted on a high bank on the outside of a curve which the river made at that point. It is considered that these banks will need spur protection in the immediate future.

During the recent floods it was noted that the collapsible bridges were as much as 3 feet under the surface of the water before the top floated off. This is due, no doubt, to the weight of the steel cable which anchors the deck to the bank. In another instance the deck was floated off when the water was 4 inches over the top. In the latter case, however, the runways had been detached from the cable while along the bank and then placed on bents fastened to the shore temporarily with a hemp cable, so that the deck might be replaced immediately. Before the steel cable could be replaced, however, the river came up again and floated the deck.



The prize bridge, Kilometer 37.8, Lingayen-Camp One Road, Pangasinan Province.

### RIZAL.

Construction of the Mariquina Diversion Road was commenced at the beginning of the rainy season and it has been with difficulty that the road has been kept open because of the heavy storms. Right of way matters held up the opening of this work until too late to complete it in satisfactory shape.

The resurfacing of the Manila-North Road from the Manila line to the Bulacan boundary has been completed at a cost of approximately ₱2,600 per kilometer. Talim Island crushed rock was placed on this to a depth of 5 centimeters. Two and one-half kilometers of this is 5-meter surfacing and the balance 4-meter. The 5-meter width is along side the electric-railway track. On this section the rock was delivered by street cars to just the point used at a cost of ₱4.85 a cubic meter. The average cost of rock on the other section was the same, as it was delivered by water transportation, giving an average haul of a little over a kilometer. Three hundred meters of this section was realigned. Two additional culverts were constructed and others repaired. The work was completed at the rate of about 2½ kilometers per month and was greatly delayed by three continuous weeks of bad weather.

The inundation of the first part of September did a great deal of damage to first-class roads east of Pasig. All available road rollers have been kept busy ever since repairing washouts in subgrade and replacing surfacing washed away. The water in this flood completely surrounding the provincial building, wrecking the street-car waiting station near the building and washing out a good portion of the provincial grounds. The subgrade of the electric railroad was carried away for some 3 meters between the provincial building and the Pasig Bridge.

Appropriations are available and materials are on hand for resurfacing the 3 kilometers of the Manila-Antipolo Road through Pasig as soon as a road roller is obtainable. This section is worn through in many places and has been in need of resurfacing for a couple of years. Two inches of crushed rock will be placed on the present surfacing to a 4-meter width.

Work has been started making first class 3 kilometers of the Manila-Novaliches Road. This road leads through one of the friar-land estates and opens up a rich agricultural country. The proposed construction goes as far as the barrio of Balintawak where is located the famous monument to Filipino independence. It is proposed to continue the grading beyond this point to afford employment to the many men out of work in this section. Any Insular aid that may be given with this end in view will probably be devoted to this project as it leads from the populous Santa Cruz district of Manila.

Material has been ordered from the States on cable requisition for reconstructing the 2 kilometers of asphalt surfacing on the Manila-South Road. Extensive resurfacing of the worst sections of other portions of this road are contemplated as soon as the typhoon season is over and material can be delivered by water transportation in Manila Bay. No reoiling of any of the oiled sections is proposed on account of lack of funds.

Maintenance of the recently constructed municipal streets in Pasay has been turned over to the district engineer to administer in connection with other first-class road maintenance.

Construction work on the Pasay market and tiendas is progressing favorably even though greatly delayed by the recent continued rains and flood. The market is under contract to Mr. Tan Samco and the tiendas to Mr. Isidoro Reich. It is anticipated that this project will be completed on contract time which expires late in November.

The contract for the Antipolo kioskos was awarded just after the outbreak of the European war, but was refused by the bidder because of the great increase in prices since the bids were opened. The papers have been referred back to the municipal council and it is anticipated the construction will be authorized by administration.

Plans are being drawn by the district engineer for a small domestic-science school in Antipolo. This is to be of timber with a composition roof, because of the urgent need for the building and the scarcity of funds.

It is expected that construction on the provincial high school will be begun at an early date. This is to be a modified plan No. 20 with tile roof. The building will cost about ₱75,000. In connection with this building the Consulting Architect is developing a beautification scheme for this section of Pasig.

Two other standard schoolhouses are in project, both plan No. 7, one at Taytay and the other at Parañaque.

The construction of the Mariquina Central School has been terminated and turned over to the Director of Education. This work consisted of remodelling a large Spanish house, cutting out and putting in partitions, repairing roof and floor timbers, and otherwise changing a dwelling house into a structure suitable for school purposes.

Two bridges have had money appropriated for their construction and the work is awaiting the dry season.

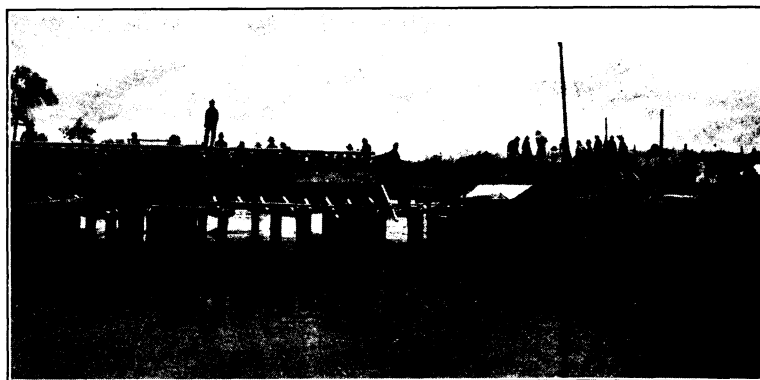
Various minor repairs and alterations to the extent of ₱2,500 classified under the maintenance of the provincial building, provincial school, provincial jail, and Caloocan, market have been and are being carried on at present by the maintenance force of the district engineer.

Surveys have been recently made of proposed market sites at Macati and San Juan del Monte for the Executive Secretary.

Boundary survey and location work between the municipalities of Cardona and Binangonan has been partially completed, but is held pending an investigation by the Supreme Court of the legality of Executive Order No. 66, series 1914.

### SAMAR.

Approval has recently been received to finish the first-class road from Candaracol to Sulat, 2 kilometers of which were completed some time ago, leaving a little over 2 kilometers to be done. This is the end of the Borongan-North Road on east Samar. Construction will begin soon.



Bridge 0.7, Calbayog-North Road, Samar Province.

An Insular allotment is now available for the Calbayog-North Road, and will be expended on bridges and culverts between the barrio of Sabang and the municipality of Oquendo. The road proper will not be touched until more funds are appropriated for that purpose.

Efforts are being made to get out gravel for school construction on the northeast coast of Samar. Rock is very difficult to find. On one project it was necessary to pay as high as ₱8 per cubic meter for gravel.

A preliminary road survey is now in progress between the provincial capital and Wright.

The Calbayog market, a type "A" building with one block of open tiendas is nearing completion. It is expected that a sufficient balance will be left from the appropriation to permit the construction of a block of double tiendas.

Two of the reinforced-concrete pile bridges are now finished on the Calbayog-North road, a third is practically done, and work is progressing satisfactorily on the others of the Calbayog-South Road.

**SORSOGON.**

Although the baguio of June 18 did not do any great amount of damage, the heavy rains of July, August, and the first part of September were most destructive, so much so, that by August the province has been damaged to a considerable extent.

On the Bulan-Irocin Road the binder was washed out on most of the 21 kilometers, causing a loose surfacing that is hard to repair, as there is but one road roller in the province and this is in the district around Sorsogon. Slides continually kept coming down on kilometers 10, 11, 13, 14, 15, 16, 17, and 18, none of them of any great size, but all sufficient to block up the ditches and portion of the road. A large portion of the slides consisted of large boulders, some containing as much as 5 cubic meters, which made the clearing expensive.

The damage on the roads around Sorsogon was principally in the surfacing being scoured and a few small earth slides. The roads in this district are now again in excellent condition.

The damage in Masbate was also severe, particularly on the short Macatul Point Road that serves the Colorado and Syndicate mines; on this road traffic is exceedingly heavy and the road being newly constructed without the use of a road roller is now in a very indifferent condition.

The Sorsogon-Gubat section of the Sorsogon-South Road is now entirely completed and grading is progressing rapidly from Gubat south toward Barcelona and Bulusan. No surfacing has yet been placed, but contracts have been let, and a considerable quantity of stone has been delivered close to the road for 50 centavos per cubic meter. The surfacing will be started as soon as the road roller has finished the patching and resurfacing made necessary by the recent storms.

All bridges have been completed between Sorsogon and kilometer 37 on the Sorsogon-South Road, thus opening up the road to regular automobile traffic, although some parts of it are not first class, being a mixture of sand and clay. Experience has proved, however, that this stands up very well under light automobile trucks.

At 8.45 p. m. on September 16, 1914, a severe earthquake was felt in Irocin and Bulan and to a minor degree in all other towns of the province, but no serious damage was done. The porch columns of the Irocin Central School that had only just been cast were unaffected, although some old masonry walls in the near vicinity were thrown down.

The Irocin Central School is now nearing completion, thanks to the help of the Bureau of Public Works auto truck No 18. Without this truck it would have been absolutely impossible to build this school for anything like the amount available, ₱14,000. This truck has been able to transport all Government materials free of cost, and over and above expenses to turn in some few hundred pesos for the funds of the construction of the school.

Materials have been ordered for the construction of a plan No. 3 standard school building at San Fernando on the Island of Ticao. Work will be started on the completion of the Irocin Central School, probably about the middle of October.

Considerable difficulty is being experienced in drilling the well at the Colorado Landing in Aroroy. Nothing but solid rock has been found at a depth of 500 feet. In the town of Magallanes, however, water was struck at 400 feet that pumped 30 gallons in a minute, but the well is being deepened in the hope of getting a free flow.

**SURIGAO.**

The surfacing on the Placer-Mainit Road has been finished to kilometer 8 and grading is completed to kilometer 17.

Materials are being delivered for the Lingig School and construction will be commenced at once. This building is to be a standard plan No. 2.

The provincial board has requested an Insular loan of ₱40,000 for extending the Surigao-Sison Road, and the matter is now in the hands of the Executive Bureau. The plan is to appropriate provincial funds from year to year to complete this road to a junction with the Placer-Mainit Road. The Cansuran Placer Mining Company has built 6 kilometers of gravel road to a point near the Surigao-Sison Road. This private road is open for use by the public and has opened up a very fertile and productive valley. The mining company has offered to furnish timber at their mill free of cost and tramway for transporting the material for the construction of a bridge connecting their road with the provincial highway.

**TARLAC.**

The construction of the Camiling presidencia is progressing rather slowly at present, due to excessive rains.

Work on the Tarlac market is now going on. It is a standard market of the "B" type and is 24 by 39.10 meters in dimensions. This construction is under contract with Contractor Tam Samco at ₱16,730.

No bids were received for the Gerona market, and the construction is now being undertaken by administration. This market is 24 by 42.8 meters in dimensions and is of the "A" type. The total appropriation amounts to ₱18,000.

Besides the construction now under way of the La Paz and Mata-talaib Schools, both of plan No. 3, Bureau of Education, the district engineer has already received authorization to construct the following schools: One plan No. 3 in the barrio of Bani and one plan No. 2 in the Barrio of Balaoang, both in the municipality of Paniqui.

Heavy floods have been reported from all over the province during the period from August 21 to September 2. The Tarlac River especially was very high. Twenty lineal meters of asphalted surfacing was washed out on the Tarlac-Victoria Road, but the overflow sections on the Tarlac-Gerona Road suffered no damage. The water-bound macadam on 4 kilometers of this road lost its binder, however. Considerable portions of the new fills at the Bilad Bridge were lost, but the Tarlac Dike stood up very well, indeed. The floods were fully as bad as those of 1906.

**TAYABAS.**

Lucena High School, plan No. 20, with 4 additional rooms, and 2 concrete lavatories, all constructed by administration, was dedicated August 17 by Vice-Governor Martin. At night a large dance was thoroughly enjoyed. With the many sparkling electric bulbs amidst the green festoons a very pleasing scene was presented to the spectator. The building, estimated to cost ₱76,500 was completed at a cost, including surcharges, of ₱69,853. It occupies one side of the main road leading to Lucena, while directly opposite is the new 14-room central school. The grounds are extensive, comprising 6 hectares. It is planned to construct a dormitory and trade school later on, thus forming a nucleus of what might be considered a small college.

Candelaria School, plan No. 10, Bureau of Education, also constructed by administration, has been completed and accepted.

Mogpog School, plan No. 10, and Torrijos School, plan No. 3, have been completed under administration and are ready for acceptance.

The Sariaya waterworks system has been completed. Mrs. Riggs, the wife of the Secretary of Commerce and Police, inaugurated the system on July 17. Fifty-one hydrants furnish fire protection. An effective pressure of 125 pounds per square inch is maintained. The system was constructed within the estimate.

The last unconnected link in the first-class Manila-South Road between Manila and Atimonan (distance 179 kilometers), has been completed. One can travel between Manila and Lucena (138 kilometers) by auto in three and one-half hours and between Manila and Atimonan (179 kilometers) in five hours.

The municipal council of Lucena and Tayabas have each appropriated ₱300 for the survey of proposed waterworks. The survey for the town of Tayabas is now being plotted. The source of the water supply is a spring on Mount Banahao with a daily flow of 3,000,000 gallons. Length of pipe line required for Tayabas, 3.4 kilometers, total fall 160 meters.

Market construction is under way by administration in the towns of Sariaya, Lucena, and Mauban. Plans are being made for Pagbilao, Atimonan, Tayabas, Candelaria, Lopez, Calauang, and Tiaong.

A school building is being constructed under administration from plan No. 3, Bureau of Education, in the town of Alabat. This town is rather inaccessible, being located on the large island of the same name in the Pacific.

Contractor A. F. Allen is making good progress on his contract for five bridges on the Atimonan-Gumaca Road. These consist of three concrete pile-bent bridges and two single 11-meter girder-span bridges.

During the severe storm and floods of early September no rain fell south of Pagbilao. The contrast was very marked, one side of the mountain divide clear into Manila characterized by water and floods, the other side by sunshine and dry roads. The damage to the roads due to the rains was slight, ₱1,500 for the first class and ₱600 for the second class.

**ZAMBALES.**

During the quarter the following bridges on the Iba-Subic Road have been completed with the corresponding total cost:

Santa Rita Bridge, three 7-meter spans.....	₱8,933.73
Talus Culvert, 3.5 by 2.5 meter double span.....	2,726.35
Kapanikian Culvert, 3.5 by 2.5 meter double span.....	3,234.53
Kaluluuan Culvert, 3.5 by 2.5 meter double span.....	2,948.04
Aniguay Culvert, 3.5 by 2 meters double span.....	2,424.73

Piles are being cast for Pamatauan Bridge No. 62.9, six 7-meter spans, on the Iba-Subic Road.

Materials for the substructure of Dinumagat Bridge on the Iba-Subic Road are being received and the casting of piles will soon begin.

The recent flood of September 3, 1914, has done considerable damage to the roads throughout the province. The San Felipe River, the

"traveling river" described in the October, 1913, BULLETIN, has flooded the country between kilometer 32.2 and kilometer 37, Iba-Subic Road, reaching an average depth on the present road of about 1 meter. Riceland either scoured out or filled with sand during this flood is estimated at about 300 hectares.

The deep-well rig at Iba has failed to bring up fresh water and the work was suspended.

## GENERAL ITEMS.

### A DIRECT TOLL UPON MOTOR VEHICLES.

In the bill providing for the construction of the Great West Road leading out of London, England, there is included a clause providing for a toll of three-eighths of 1 penny per mile on each motor omnibus using the road.

Considerable interest in this proposed toll is being manifested by highway engineers and officials throughout Great Britain, and in road building circles on the other side the matter is the subject of much discussion. The motor omnibus, especially in the areas surrounding London and other large cities in England, is an important and somewhat troublesome factor in the traffic. This particular type of vehicle is not used so much in this country, but it is becoming more common here and there is likelihood that its use will continue to increase. For this reason, the present controversy in England between those who favor and those who oppose the imposition of a direct toll is of interest to American engineers.

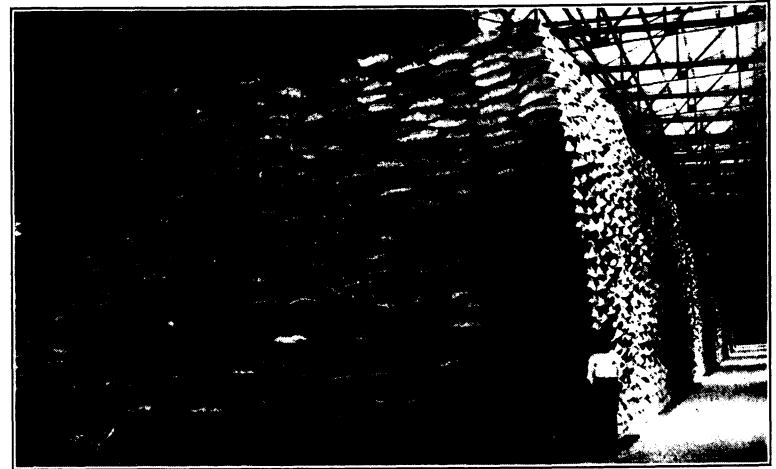
The experience of highway engineers in England seems to show conclusively that the heavy motor bus is peculiarly detrimental to road surfaces. Its injurious effects are magnified by its frequent stopping and starting to take on and discharge passengers, and it is a not infrequent cause of annoyance to the drivers of other vehicles, especially on narrow roads where the comparatively slow moving bus may hold back a considerable number of swifter vehicles. Taking these facts into account, it would seem just to assess some portion of the cost of road maintenance upon these vehicles.

It is a sound principle that users of the highways should be taxed proportionately as they wear the road. Unfortunately, however, the principle can not be applied with accuracy. In the case of all traffic, except that which is purely for pleasure—and to a certain extent even in that case—the actual driver or owner of the vehicle is not the only one to benefit from the road and, therefore, not the only one who, in justice, should help pay for it. In the case, however, of what at present may perhaps be called extraordinary traffic, such as that of heavy motor buses operated by private companies, it would seem not unjust to levy some tax. It may be argued, of course, that as common carriers these vehicles serve the public and that, therefore, their owners should not be called upon to relieve the taxpayers of the burden of keeping up the public roads. But this is easily answered by calling attention to the fact that in all cases "the consumer pays the freight." If the motor-omnibus companies are obliged to pay a fixed toll per vehicle per mile for the use of the public highways there is no question but that they will so adjust their fares as to reimburse themselves, thus shifting the payment of the tax to the passengers. Since this method would take the burden from the general public and place it upon that particular part of the public which uses the motor omnibus service, it would seem that the only phase of the matter open to discussion is the amount of the toll to be imposed. This, as pointed out, should be proportionate to the damage done, but to determine its amount in accordance with that principle would be a matter of some difficulty.

Whatever the outcome of the present controversy may be, the problem is one of interest to American engineers as one which they may have to meet in the not far distant future.

### A FLOOR TEST.

The concrete floors of the Bureau of Supply bodegas are, as may be seen from the accompanying illustration, undergoing a very thorough and complete test. The illustration shows a portion of the 8,000 sacks of rice purchased by the Insular Government in anticipation of a possible lack of food supply brought about by war conditions. The rice is piled 30 sacks high, and an actual weight of



Nine hundred and six pounds per square foot.

906 pounds per square foot has been developed on the floor without any indications of settlement or even perceptible deflection. This floor was laid after the bodegas had been completed.

A description of the methods of construction together with plans may be found on page 49, Vol. 2, No. 1 of the April 1, 1913, issue.

## FINANCIAL.

### APPROPRIATIONS AND ALLOTMENTS.

All funds appropriated for roads and bridges for the Insular fiscal year beginning January 1, 1914, have been allotted and deposited.

### LOANS FOR ROADS, BRIDGES, SCHOOLS, MUNICIPAL AND PROVINCIAL BUILDINGS, ETC., FROM JULY 1, 1914, TO SEPTEMBER 30, 1914.

Province and project.	Act Numbers.			Total.
	1728.	1749.	2083.	
Albay: Camalig market.....	P2,000	P8,000		P10,000
Ambos Camarines: Bridges and culverts.....			P100,000	100,000
Bohol: Loay, Panangatan bridges, and Balbalan bridge, and five culverts on Tagbilaran-East Road.....	10,000		90,000	100,000
Ilocos Sur:				
Santo Domingo market.....	3,000	12,000		15,000
Masingal municipal building.....		4,000		4,000
Iloilo: Balasan central school building.....		5,000		5,000
Laguna:				
Balanag bridge (Pagsanjan).....	10,300	2,000		12,300
High School.....			50,000	50,000
Nueva Ecija:				
Cabanatuan market.....	2,400	9,600		12,000
Talavera bridge.....			40,000	40,000
Rizal: High School.....	10,000	15,000		25,000
Zambales: Balinbacbac, Bagatalinga, Pamatonan, and Dinomagat bridges.....	12,000	48,000		60,000
Total.....	49,700	103,600	280,000	433,300

### IN RELATION TO J. CÆSAR, ROAD BUILDER.

When Cæsar took an eastward ride and grabbed the Gauls of Rome,  
What was the first thing that he did to make them feel at home?  
Did he increase the people's loads and liberty forbid  
No; he dug in and built good roads—that's what old Cæsar did.  
Did Cæsar put the iron heel upon the foeman's breast,  
Or did he try to make them feel that Roman rule was best?  
What did he do, to make them glad he came their lands amid?  
He built good roads in place of bad—that's what old Cæsar did.  
He built good roads from hill to hill, good roads from vale to vale;  
He ran a good-roads movement 'till old Rome got all the kale.  
He told the folks to buy a home, build roads their ruts to rid,  
Until all roads led up to Rome—that's what old Cæsar did.  
If any town would make itself the center of the map,  
Where folks will come and settle down and live in Plenty's lap,  
If any town its own abodes of poverty would rid,  
Let it go out and build good roads—just like old Cæsar did.

—Ohio State Highway Department Monthly.



## APPENDIX A.

### CIRCULAR LETTERS ISSUED BY THE CONSTRUCTING DIVISION FROM JULY 1, 1914, TO SEPTEMBER 30, 1914.

MANILA, March 30, 1914.

*Constructing Division Circular No. 135.*

SIR: I have to invite your attention to the attached copy of Provincial Division Circular No. 302 of the Bureau of Audits relative to the surcharges which will govern in connection with the prosecution of public works in compliance with the provisions of Act No. 2319.

You will carefully observe and comply with the instructions contained in the above mentioned circular.

For the Director:

E. J. WESTERHOUSE,  
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,  
HIGHWAY AND SENIOR SUPERVISING ENGINEERS.

"THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
"BUREAU OF AUDITS,

"Subject: Surcharges, public works.

"MANILA, March 19, 1914.

"Provincial Division Circular No. 302.

"Provincial treasurers:

1. Act 2319, the Appropriation Act for the current calendar year, provides for the payment of district engineers' salaries by the Bureau of Public Works. These payments will be made direct by the Bureau on and after January 1, 1914. In case any salary payments have been made by provincial treasurers for service during the current year, a refund of same should be obtained.

"2. The traveling expenses of district engineers and the salaries and authorized official expenses of all other public works employees will be paid by the provincial treasurer and accounted for in the manner prescribed heretofore; the only difference being in the payment of the district engineer's salary.

"INSULAR SURCHARGE.

"3. The above-mentioned Act also contains the following provision:

"Provided, That the total herein appropriated for administrative expenses and direct charges shall be offset by the automatic reversion to the general unappropriated surplus of all income and receipts of whatever nature resulting from the correct allocation of costs to each project: *Provided, however,* That when the services of the Bureau of Public Works in connection with any provincial or municipal project are purely administrative or supervisory, the charges of said services shall be computed upon the basis of not to exceed three per centum of the total cost of said project: *And provided further,* That in case the amount thus derived is insufficient to cover the cost of said services, the difference shall be borne by the appropriation for the Bureau of Public Works."

"4. It will be noted that the above-quoted law requires a distribution of the expenses of the Bureau of Public Works to all projects carried out under its supervision. While this provision applies equally to all projects whether Insular, provincial, or municipal, the actual amount which may be collected from projects carried out with provincial or municipal funds, is limited to 3 per cent of the cost thereof. This will make it necessary, beginning with the month of January, to first apply the provincial surcharge on all expenditures during the month from all public works projects. To the total expenditures thus obtained, the Insular surcharge will be applied; the various accounts being charged with the amount thereof, while, in the case of provincial or municipal funds, 3 per cent will be credited to accounts payable, Bureau of Public Works, and the balance, being that part of the supervision charges, which the Insular Government proposes to give to the provinces and municipalities, will be taken up as 'Insular aid' and credited back to the respective project accounts from which derived.

"5. Those funds which are turned over to the provinces from time to time under the caption of 'Insular aid' will be considered to be provincial funds in the application of surcharges.

"6. The Insular surcharge is applicable to all Insular Government projects, but in these cases the full amount of the surcharge inures to

the Insular Government. *Provincial treasurers will take no action in applying the Insular surcharge to projects under schedule 'U' until requested to do so.* The procedure of withholding the amount of the surcharge from *Insular funds advanced* for public works in the provinces will be followed hereafter. The Bureau of Public Works will bill upon the provinces the amount of the surcharge pertaining to unexpended balances of Insular funds in the hands of provincial treasurers on January 1, 1914, and also upon any advances made during the period from January first to date.

"Insular projects—that is, projects carried out with Insular funds (advances for disbursement) under the supervision of the district engineer—will be subjected to the provincial surcharge in the same manner as provincial projects.

"7. The Insular surcharge will be fixed by the Director of Public Works with the approval of the Insular Auditor, and will be changed whenever such action is found necessary. *Beginning with January and until further notice the Insular surcharge will be 12½ per cent.*

"8. Appropriation accounts for purchase or for maintenance of equipment will not be subject to any surcharge, either Insular or provincial.

"9. In order to facilitate the accounting in the provinces and also in the Bureau of Public Works, provincial treasurers will formulate a monthly statement of public-works expenditures promptly at the close of business at the end of each month in the following form. This statement is similar to that heretofore used, excepting such changes as have been made necessary by changes in the law. A new form, similar to that used in the following page, and designated Provincial Form 57 (A), 'Monthly Statement of public works expenditures,' will be furnished provincial treasurers upon blanket requisition of this office as soon as the same has been printed.

#### "MONTHLY STATEMENT OF PUBLIC-WORKS EXPENDITURES.

"I certify that the following is a true and correct statement of all expenditures made by me upon public works under the supervision of the Bureau of Public Works, during the period July 1 to 31, 1911:

Project.	Ac- count.	Ex- pendi- tures.	Pro- vincial sur- charge.	Total.	Insular aid.	Bureau of Public Works 3 per cent sur- charge.	Total sur- charge.
Provincial building .....	B-52-1	P8,000.00	P400.00	P8,400.00	P798.00	P252.00	P1,450.00
Provincial jail .....	B-52-3	2,000.00	100.00	2,100.00	199.50	63.00	362.50
High school dormitory .....	B-53-2	3,000.00	150.00	3,150.00	299.25	94.50	543.75
Bac-Bac bridge .....	C-54-9	7,000.00	350.00	7,350.00	698.25	220.50	1,268.75
Cebu-Toledo Road .....	C-54-11	8,000.00	400.00	8,400.00	798.00	252.00	1,450.00
Calamba-Los Baños Road, Act 1954 .....	C-54-7	10,000.00	500.00	10,500.00	997.50	315.00	1,812.50
Pasig-Antipolo Road, Act 1988 .....	J-54-3	4,000.00	200.00	4,200.00	399.00	126.00	725.00
Boso-Boso-Biga Road .....	K-54-13	1,000.00	50.00	1,050.00	99.75	31.50	181.25
Santa Cruz barrio school Act 1801 .....	O-13-12	500.00	25.00	525.00	49.88	15.75	90.63
Pasig barrio school Act 1801 .....	O-23-61	200.00	10.00	210.00	19.95	6.30	36.25
Santa Ana barrio school .....	O-20-65	400.00	20.00	420.00	39.90	12.60	72.50
Cavite market loan .....	O-12-59	2,000.00	100.00	2,100.00	199.50	63.00	362.50
Cebu Harbor improvements, Act 2319 .....	U-19	3,000.00	150.00	3,150.00	-----	-----	150.00
Total .....		49,100.00	2,455.00	51,555.00	4,598.48	1,452.15	8,505.63

"10. The above statement will be made in quintuplicate; two copies will be forwarded to this office as soon as possible; one copy to the district engineer; one copy will serve as a voucher in the provincial treasurer's accounts in support of the distribution entries; and one copy will accompany the remittance when payment is made to the Bureau of Public Works.

"11. The entries necessary to bring the above statement into account will be made before taking off the trial balance. In this way the trial balance will present the true financial condition of the projects, as far as actual charges are concerned, up to the date thereof.

"12. The following entries, bringing into account the model statement in paragraph 8, are given as illustrative of the manner in which accounting for surcharges will be made:



"Entry for model statement.

	Class.	Debit.	Credit.
Provincial building	B-52-1	P1,450.00	
Provincial jail	B-52-3	362.50	
High school dormitory	B-53-2	543.75	
Bac-Bac bridge	C-54-9	1,268.75	
Cebu-Toledo Road	C-54-11	1,450.00	
Calamba-Los Baños Road, Act 1954	C-54-7	1,812.50	
Pasig-Antipolo Road, Act 1988	J-54-3	725.00	
Boso-Boso-Biga Road	K-54-13	181.25	
Santa Cruz barrio school, Act 1801	O-13-12	90.63	
Pasig barrio school, Act 1801	O-23-61	36.25	
Santa Ana barrio school	O-20-65	72.50	
Cavite market loan	O-12-59	362.50	
Cebu Harbor improvements, Act 2319	U-19	150.00	
Engineering expenses	A-7-1		P2,455.00
Accounts payable Bureau of Public Works	S-?		1,452.15
Revenue received, general fund	Ba		1,296.75
Revenue received, road and bridge fund	Ca		2,493.75
Revenue received, Pasig-Antipolo road fund, Act 1988	Ja		399.00
Insular aid fund, unappropriated	K		99.75
Santa Cruz barrio school, Act 1801	O-13-12		49.88
Pasig barrio school, Act 1801	O-23-61		19.95
Santa Ana barrio school	O-20-65		39.90
Cavite market loan	O-12-59		199.50
Aid from Insular Government	Ba94	1,296.75	
Do	Ca94	2,493.75	
Do	Ja94	399.00	
Insular aid fund, unappropriated	K	99.75	
General fund, unappropriated	B		1,296.75
Road and bridge fund, unappropriated	C		2,493.75
Pasig-Antipolo Road fund, unappropriated, Act 1988	J		399.00
Boso-Boso-Biga Road	K-54-13		99.75
General fund, unappropriated	B	1,296.75	
Road and bridge fund, unappropriated	C	2,493.75	
Pasig-Antipolo Road fund, unappropriated, Act 1988	J	399.00	
Provincial building	B-52-1		798.00
Provincial jail	B-52-3		199.50
High school dormitory	B-53-2		299.25
Bac-Bac bridge	C-54-9		695.25
Cebu-Toledo Road	C-54-11		798.00
Calamba-Los Baños Road, Act 1954	C-54-7		997.50
Pasig-Antipolo Road, Act 1988	J-54-3		399.00
Total		16,984.38	16,984.38

"13. The early submission of the form of statement herein provided for the months of January and February, 1914, is requested, and it is also desired that prompt attention be given to the same at the end of each month hereafter.

"14. Municipal projects, which are placed under the supervision of the Bureau of Public Works, and for which the municipal treasurer acts as disbursing officer, will be subject to the 3 per cent surcharge of the Bureau of Public Works and also to the regular provincial surcharge. Certificates covering such municipal expenditures will be prepared at the close of each municipal audit by the district auditor, in quadruplicate. Two copies of the certificate will be forwarded to the Insular Auditor; one will be furnished the provincial treasurer; and one will be filed. Expenditures for the construction of municipal school buildings will be subject to the provincial surcharge in addition to the Insular surcharge, but in such cases the provincial surcharge will not exceed 7 per cent.

"15. Paragraphs 27, 28, 29, 41a, 51, and 52 of Provincial Division Circular No. 202, and Provincial Division Circulars Nos. 228 and 256 are hereby revoked, and all previous instructions are amended accordingly.

"C. H. FRENCH, *Insular Auditor.*

"Concurred in:

"(Sgd.) IGNACIO VILLAMOR, *Executive Secretary.*"

MANILA, April 16, 1914.

*Constructing Division Circular No. 136.*

SIR: The original of all time records of district engineers should be made out promptly at the end of each month and forwarded immediately to the Director of Public Works. This is necessary from an accounting viewpoint, and while salary checks for the preceding month will not be delayed to receive these time records, nevertheless, salary checks for following months will be withheld unless the time records are received within a reasonable time after the expiration of each month.

For the Director:

E. J. WESTERHOUSE,  
*Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,  
HIGHWAY AND SENIOR SUPERVISING ENGINEERS.

MANILA, May 6, 1914.

*Constructing Division Circular No. 137.*

SIR: I have to invite your attention to the inclosed Provincial Division Circular No. 308 of the Bureau of Audits relative to overdrafts.

This circular has an object in view distinctly commendable from an engineer's standpoint, and harmonious and helpful coöperation with the officials concerned will secure the maximum of good results from the funds expended and tend to conserve the public interest in your district.

For the Director:

E. J. WESTERHOUSE,  
*Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,  
HIGHWAY AND SENIOR SUPERVISING ENGINEERS.

"THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
"BUREAU OF AUDITS.

"MANILA, April 16, 1914.

"Subject: Overdrafts.

"Provincial Division Circular No. 308.

"Provincial treasurers:

"Since the major part of provincial revenues are collected within a short period of the year, it has been deemed expedient to provide more elastic requirements in the expenditure thereof in order that special conditions that arise from time to time may be met in a practicable manner. It sometimes occurs that the immediate expenditure of funds for maintenance or construction of public works or for other purposes will have the effect of avoiding the expenditure of a much greater amount if the matter is delayed.

"In order to meet such conditions, this office will amend its previous requirements in the matter of overdrafts in provincial funds as follows: Hereafter overdrafts in any provincial funds, excepting 'K' fund, in an amount not exceeding 50 per cent of the uncollected amount accruing to the fund as shown by the provincial budget, will not be questioned in audit, provided, however, that all overdrafts shall be closed out by the end of the calendar year.

"It is suggested that good management will preclude provincial treasurers from unnecessarily expending up to the limit herein allowed, as such action would eliminate the desired elasticity, the very object to be attained by these modified instructions.

"The previous instructions from this office regarding overdrafts in all funds other than those covered by this circular will be continued in force and rigid compliance therewith will be required.

"All previous instructions of this office inconsistent with this circular are hereby revoked.

"C. H. FRENCH, *Insular Auditor.*

"Approved:

"(Sgd.) IGNACIO VILLAMOR, *Executive Secretary.*"

MANILA, May 6, 1914.

*Constructing Division Circular No. 138.*

SIR: Your attention is invited to the attached list of standard plans for bridges and culverts, showing the Bureau of Public Works file number, type of structure, size, date plan made, and date of last revision.

You are directed to carefully examine and check against this list all the standard plans in your office. Any plans found not to be of the latest date should be discarded and new prints requisitioned. In ordering standard plans care should be taken to order by file number only.

For the Director:

E. J. WESTERHOUSE,  
*Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,  
HIGHWAY AND SENIOR SUPERVISING ENGINEERS.

MANILA, May 9, 1914.

*Constructing Division Circular No. 139.*

SIR: Your careful attention is invited to the attached circular of the Purchasing Agent, Manila, relative to rush requisitions for small amounts of explosives, fuse, and caps.

You will, in future, in submitting rush requisitions for the above-mentioned supplies, be governed by the information and instructions contained in said circular.

For the Director:

E. J. WESTERHOUSE,  
*Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,  
HIGHWAY ENGINEER,  
SENIOR SUPERVISING ENGINEERS, and  
Mr. S. LIBBY, *Traveling Inspector.*

"OFFICE OF THE BUREAU OF SUPPLY,  
"Manila, P. I., May 6, 1914.

"Circular letter.

"Notice is hereby given that rush orders for small amounts of explosives, fuse, and caps cannot be supplied promptly owing to the fact that the explosives, fuse, caps are now stored in the powder magazine, Talim Island, Laguna de Bay, approximately a distance of 30 miles from Manila. Requisitioners are requested to anticipate their wants for these supplies, and have their requisitions at the Bureau of Supply at least fifteen days in advance of the time the explosives and accessories are required for use.

An additional cost of ₱70 on each small lot over cost of material will be made, if rushed, on account of the extra expense involved in securing the material *rush* from the magazine.

"(Sgd.) E. G. SHIELDS, *Purchasing Agent.*"

MANILA, May 18, 1914.

*Constructing Division Circular No. 140.*

SIR: It has been observed that some of the district engineers have misinterpreted Circular No. 135, relative to Bureau of Audits Provincial Division Circular No. 302, as to the 9½ per cent Insular aid.

In keeping Form 251, the provincial surcharge as fixed and the Insular surcharge of 3 per cent is taken up as an obligation as soon as the money is available, and the said obligation is reduced from time to time by the amounts certified by the provincial treasurer; the Insular aid, 9½ per cent, however, is disregarded as a surcharge obligation but is taken up under certified expenditures, column 4, Form 251, from statement of surcharges furnished monthly by the provincial treasurer, this amount being immediately credited to the appropriation, but said amount not being subject to surcharges.

This to take effect January 1, 1914.

For the Director:

E. J. WESTERHOUSE,  
*Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,  
HIGHWAY AND SENIOR SUPERVISING ENGINEERS.

MANILA, June 15, 1914.

*Constructing Division Circular No. 141.*

SIR: You are directed to ascertain the following information:

1. The linear meters of ingot-iron culverts placed during the year July 1, 1913, to June 30, 1914, stating the diameter and the length of each diameter placed.

2. The probable installation of ingot-iron culverts, stating length and diameter, for the year July 1, 1914, to June 30, 1915.

Expedition is directed.

For the Director:

E. J. WESTERHOUSE,  
*Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,  
HIGHWAY ENGINEERS,  
SENIOR SUPERVISING ENGINEERS,  
DEPARTMENT ENGINEER, MINDANAO AND SULU, and  
CITY ENGINEER, BAGUIO.

MANILA, June 23, 1914.

*Constructing Division Circular No. 142.*

SIR: I have to invite your attention to the attached copy of Provincial Division Circular No. 314, of the Bureau of Audits, and to direct the fullest coöperation with the provincial treasurer and district auditor in the regulating of the provincial surcharge of your district. Care should be taken that the provincial surcharge covering engineering expenses (A-7-1) should at no time exceed 7 per cent.

For the Director,

E. J. WESTERHOUSE,  
*Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,  
HIGHWAY ENGINEER,  
SENIOR SUPERVISING ENGINEERS, DEPARTMENT ENGINEER,  
MINDANAO AND SULU,  
CITY ENGINEER, BAGUIO, and  
TRAVELING INSPECTOR.

"THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
"BUREAU OF AUDITS.

"Subject: Provincial surcharge.

"Provincial Division Circular No. 314.

"MANILA, June 8, 1914.

"Provincial treasurers and district engineers:

"The rate of the provincial surcharge on public-works expenditures will be fixed by a committee in each province consisting of the provincial treasurer, the district engineer, and the district auditor as soon as practicable after January 1 of each year, at the per cent

that the aggregate of the engineering expenses for the ensuing calendar year bear to the total estimated expenditures to be made during the same period for public works to which the provincial surcharge is applicable.

"This committee is also charged with the duty of revising the rate of the provincial surcharge from time to time as necessity may require in order that the balance in the account "engineering expenses" (A7-1) may be reduced to an unimportant amount at the close of the year.

"Paragraphs 38, 39, and 40 of Provincial Division Circular No. 202 and all other instructions inconsistent with these instructions are hereby revoked.

"C. H. FRENCH,  
"Insular Auditor.

"Concurred in:  
(Sgd.) "WARWICK GREENE,  
"Director of Public Works.

MANILA, July 7, 1914.

*Constructing Division Circular No. 143.*

SIR: Attention is invited to the attached copy of Executive Order No. 48, dated May 25, 1914. Attention is also invited to excerpt from an indorsement on this executive order and signed by the authority of the Governor-General, dated June 22, 1914.

"Referring to Executive Order No. 48, current series, the Director of Public Works is hereby authorized to secure such quotations of prices of materials and equipment as may be necessary to enable expedition in designing or estimating, provided that, where requisitions are made, calling for supplies or equipment on which such quotations have been secured, a specific notation shall be made on the requisition in question showing the quotation made and person or firm making same."

The district engineer is accordingly authorized to secure quotations and prices on materials or equipment for work under his supervision. Care is directed, however, that when the requisition is submitted for materials for which quotations have been previously secured, that the exact requirement of the above quoted indorsement, signed by the authority of the Governor-General, be conformed to and a specific notation be made on the face of the requisition, giving the quotations and prices and the person or firm making same.

For the Director,

E. J. WESTERHOUSE,  
*Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,  
HIGHWAY ENGINEER,  
SENIOR SUPERVISING ENGINEERS,  
DEPARTMENT ENGINEER,  
EXECUTIVE BUREAU,  
CITY ENGINEER, BAGUIO, and  
Mr. SOLOMON LIBBY, Traveling Inspector, Bureau of Public Works.

"THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
"EXECUTIVE BUREAU.

"MANILA, May 25, 1914.

"EXECUTIVE ORDER }  
"No. 48.

"The giving of any intimation to merchants or dealers of the probable requirements of the Government for equipment, material, or supplies as well as the soliciting of quotations, other than through the Purchasing Agent, is hereby forbidden, unless their purchase without his intervention is permitted by law, or by general or specific authority of the Executive, obtained prior to going into the market.

"FRANCIS BURTON HARRISON,  
"Governor-General."

MANILA, July 10, 1914.

*Constructing Division Circular No. 144.*

SIR: I have to invite your attention to the attached Provincial Division Circular No. 315, of the Bureau of Audits, concurred in by this Bureau and approved by his Excellency the Governor-General, relative to public-works accounting.

Strict compliance with the provisions and instructions contained in this circular and complete coöperation with the provincial treasurer and district auditor in the carrying out of same is enjoined.

For the Director,

E. J. WESTERHOUSE,  
*Chief Constructing Engineer.*

To all DISTRICT ENGINEERS,  
HIGHWAY ENGINEER,  
SENIOR SUPERVISING ENGINEERS,  
CHIEF ACCOUNTANT,  
DEPARTMENT ENGINEER,  
CITY ENGINEER, BAGUIO, and  
Mr. SOLOMON LIBBY, Traveling Inspector, Bureau of Public Works.

"THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
"BUREAU OF AUDITS.

"Subject: Public-works accounting.

"Provincial Division Circular No. 315.

"MANILA, May 14, 1914.

"Provincial treasurers and district engineers:

"1. Coöperation between provincial treasurers and district engineers is essential to the proper financing and prosecution of public works. In order to properly and intelligently carry out any public works project, the district engineer must have been advised:

"First, of the amount of funds made available for the project.

"Second, of every subsequent charge or additional amount made available.

"In order to attain the desired end, the following instructions are given:

"2. Each provincial treasurer will obtain and furnish the district engineer of the province copies of all budgets carrying appropriations for public works as soon as possible after same have been confirmed by the provincial board and entered in the accounts. The title and designation of each project will be indicated, in order that the district engineer may carry the project in his records in conformity with the treasurer's accounts. In this connection it is suggested that appropriations for road projects be made for each road as a whole, instead of by sections as has been done in a few instances. It is also desirable to restrict the number of appropriation accounts for the maintenance of first and second class roads to one account for each class, wherever such action is feasible.

"3. Each provincial treasurer will also promptly advise the district engineer in approximate form of any amounts made available for expenditure for public works, other than those provided by budgets, such as Insular appropriations, allotments, etc., indicating in each case the title and designation under which the same is carried in the provincial ledger.

"4. Provincial treasurers will promptly advise district engineers of returns of allotments of appropriations for public works to the Insular Treasury or reversions of appropriations. Also of any subsequent changes in the authority for the expenditure of allotment funds.

"5. Compliance with the above will enable the district engineer to open accounts uniformly with those of the provincial treasurer for all public-works projects and at the same time it will serve to advise the engineer in a definite manner of the work to be performed so that he can properly plan its execution.

"6. Payments on provincial projects under the supervision of the Bureau of Public Works may be made only upon vouchers bearing the approval of the district engineer or his duly authorized representatives. In other words, no charge whatsoever, except corrective entries made in compliance with the Auditor's instructions, may be made in any account pertaining to a project under the supervision of the district engineer unless the voucher supporting the entry bears the approval of the district engineer or his authorized representative: *Provided, however*, That, in case the district engineer refuses to approve a voucher covering a proposed charge against a public works account, the same may be submitted to the district auditor for decision. The officers concerned will be guided by the decision of the district auditor, unless the same is reversed or changed on appeal in accordance with the provisions of the Accounting Act. In case of the corrective entries above referred to, a copy of the journal voucher covering the same will be furnished the district engineer at the time the entries are made. These requirements are essential in order that the district engineer may have the necessary information to keep an accurate account of each and all projects under his supervision.

"7. In case vouchers covering expenditures or charges in public-works accounts are found in audit without evidence of the approval or other action required in the preceding paragraph, the same will be placed in suspension, and, in case an overdraft has been incurred by reason of the charge having been made without the knowledge of the district engineer, the provincial treasurer will be held responsible for such overdraft.

"8. It is particularly desirable that all the obligations which pertain to any month be paid and accounted for or otherwise brought into account during the month to which they pertain. Provincial treasurers will, therefore, hold their journals open for five days or such time as is necessary within the five days, after the end of each month, in order to include all obligations of the month. Obligations as contemplated herein refer to any indebtedness legally incurred in behalf of a province, the amount of which may be definitely determinable at the time.

"9. It is also essential to the keeping of accurate accounts by the district engineer and the provincial treasurer that uniform "cut off" be had at the end of each month in the charges to public works projects, thereby allowing the district engineer to check his accounts with those of the treasurer through the medium of the trial balance. Provision for a uniform closing of accounts has therefore been made in these instructions.

"10. Provincial treasurers will bring into the accounts of any month all vouchers and obligations pertaining thereto certified to them by the district engineers during the month or within five days thereafter. In case it is impracticable to make payment on vouchers before closing the accounts for the month to which the same pertain, such vouchers will be taken up in Accounts Payable pending payment.

"11. In cases where a pay roll is taken up in accounts payable pending its payment, the triplicate copy of the pay-roll jacket (summary of pay rolls—Provincial Form No. 38-A) pertaining thereto will be used as the voucher supporting the entry. The original pay roll will be used in support of the entry charging accounts payable and crediting Cash and (in case not all the laborers whose names appear on the roll are paid thereon) accounts payable—unpaid laborers, after payment has been made.

"12. When pay rolls have been taken up in accounts payable pending payment, the payments thereon should be effected and the same returned to the accounts as soon as practicable. It is believed that pay rolls should not ordinarily be held out from payment longer than thirty days.

"13. Provincial treasurers will also bring into account for the month to which they pertain such obligations as may be included in the district engineer's certified statement of obligations, by charging the accounts affected and crediting accounts payable. The "certified statement of obligations" will serve as the voucher for the entry. The auxiliary voucher (Provincial Form No. 71-A) covering credits of this character to accounts payable should be carried in a separate division of the file, thus showing the particular vouchers due from the district engineer in addition to showing the obligation.

"14. After having checked and thereby ascertained that all vouchers as shown by the report of certified vouchers have been taken into account, and having entered the items of obligations shown on the district engineer's certified statement of obligations, if any, the provincial treasurer will take off the monthly statement of public-works expenditures, required by Provincial Division Circular No. 302. After the surcharges as shown by the statement have been entered, the month's accounts will be considered closed as far as public-works transactions are concerned and the trial balance may then be made.

"THE DISTRICT ENGINEER.

"15. District engineers will keep an accurate record in connection with each project under their supervision. Immediately upon receipt of advice that an amount or amounts have been made available for public works projects, the district engineer will open accounts under the title and designation fixed by the provincial treasurer and will credit the same with the respective amounts.

"16. As obligations in connection with any such public works projects become due, the district engineer will prepare the vouchers therefor in the prescribed manner, and approve or certify to the same. The amount of the voucher will then be entered as a charge in the account to which it pertains and also entered in the "report of certified vouchers," hereinafter described. The voucher should then be promptly turned over to the provincial treasurer for payment.

"In case of labor payrolls the jacket or summary of pay rolls (Provincial Form No. 38-A) will be accomplished in triplicate. The original and triplicate to be attached to and accompany the original rolls to the treasury while the duplicate will be attached to and filed with the duplicate roll in the district engineer's office.

"17. District engineers will turn in to the provincial treasurers properly accomplished vouchers covering all obligations against public works projects, within the month in which the same have been incurred, as far as possible. Certain charges, such as labor payrolls for the last part of a month, cannot of course be presented within the month to which they pertain. However, in most cases all vouchers can be turned in within the first five days of the succeeding month, and district engineers will be allowed, where necessary, five days extension into the succeeding month to turn in vouchers covering the determined obligations of any month.

"18. Within five days after the close of each month, district engineers will furnish provincial treasurers with a complete list of the vouchers certified by them which pertain to the preceding month, giving the date, to whom payment is due, for what, and stating the title and designation of the project and amount of the voucher. A stock form entitled "report of certified vouchers" and designated as Provincial Form No. 95-A has been prepared for this purpose.

"19. In certain cases where labor is employed in remote places, it may be impossible to obtain the payrolls within the above-mentioned period. In most instances of this kind the district engineer will have been advised by telephone, telegraph or messenger of the definite amount of the obligations and will thus be enabled to certify the same to the provincial treasurer.

"20. In case the amount of any obligations incurred during the preceding month are definitely known and it is impossible to secure the vouchers so as to certify to them and turn them over to the provincial treasurer within the prescribed period, the district engineer will make out a certified statement of such obligations and submit the same to the provincial treasurer before the expiration of the five days period. A stock form designated as "certified statement of

obligations," Provincial Form No. 98-A, has been devised for this purpose.

"21. When the vouchers covering the obligations previously certified on Provincial Form No. 98-A have been obtained by the district engineer, he will in addition to certifying to them in the usual manner, write or stamp thereon "obligation previously certified." In order to avoid future question as to the whereabouts of such vouchers, it might be well for the district engineer to obtain the initials of the provincial treasurer or his deputy on the retained copy of the certified statement of obligations.

"22. District engineers will take up all vouchers as certified by them within the month to which they pertain including the surcharges as shown by the provincial treasurer's monthly statement and also such obligations as are included in the certified statement of obligations submitted to the provincial treasurer. Upon receipt of the trial balance, district engineers should promptly and carefully check all public works accounts as shown by it with their own accounts. If these instructions have been complied with, the accounts should be in full agreement. In case differences are found in any account or accounts, the same should be promptly adjusted by checking the accounts in which differences appear with the corresponding accounts in the provincial ledger.

"23. District engineers will be held responsible for any obligations incurred by them in connection with projects under their supervision in excess of the amount of funds available for such projects.

"C. H. FRENCH,  
"Insular Auditor."

"Concurred in:

(Sgd.) "WARWICK GREENE,  
"Director of Public Works.

"Approved:

(Sgd.) "FRANCIS BURTON HARRISON,  
"Governor-General."

MANILA, July 18, 1914.

*Constructing Division Circular No. 145.*

SIR: Your attention is invited to the attached General Circular No. 105 of the Bureau of Audits relative to requests for relief from accountability for losses of property or money under the provisions of section 49, Act No. 1792.

The instructions contained in said General Circular No. 105 should be conveyed to all the office and field force under your direction and carefully observed in the presentation of claims for relief from accountability.

For the Director:

E. J. WESTERHOUSE,  
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,  
HIGHWAY ENGINEER,  
SENIOR SUPERVISING ENGINEERS,  
DEPARTMENT ENGINEER, MINDANAO AND SULU,  
CITY ENGINEER, BAGUIO, and  
Mr. SOLOMON LIBBY, Traveling Inspector.

"THE GOVERNMENT OF THE PHILIPPINE ISLANDS,  
"BUREAU OF AUDITS.

"Subject: Losses of money or property; claims for relief from accountability for; under sec. 49, Act 1792.

"General Circular No. 105.

"MANILA, July 13, 1914.

"1. Requests for relief from accountability for losses of property or money under the provisions of section 49, Act 1792, should not be made upon an inventory and inspection report (General Form 17 (a)). Requests of this nature will be made in letter form addressed to the Insular Auditor and in cases where a responsible officer seeks relief the request will invariably be forwarded through the accountable officer. The letter will contain a statement of the circumstances relating to the loss, and in the case of property, the indorsement of the accountable officer will give the unit cost and classification of the articles lost, together with any additional information necessary to enable this office and that of the Governor-General to act intelligently on the request.

"2. The request for relief should be accompanied by sufficient evidence to prove the validity of the claim. This should include the affidavit of the officer who signs the request, containing a statement of the circumstances surrounding the loss, in addition to a list and description of the articles lost; also the affidavits of at least two disinterested persons having knowledge of the facts and circumstances in connection therewith. In case it is not possible to secure the statements of two disinterested persons, as above required, and only one such person, or none at all, is available, such fact should be fully

set forth in the affidavit of the person who signs the request for relief, giving the reasons therefor.

"3. When the request for relief is not made within the statutory period of one month, an explanation thereof will accompany the request.

"4. In case of death of a Government animal which is under the care of a veterinarian, the veterinarian's certificate as to the cause of death, with a description of the animal will accompany the affidavit of claimant. In case of death of an animal the failure to call a veterinarian whose services were available and necessary will tend to operate against the granting of relief.

"5. In case of death of a Government animal not under the care of a veterinarian the officer seeking relief will, if possible, furnish with his request therefor the affidavits of two or more responsible persons who have knowledge of the facts. Such affidavits should describe the animal in sufficient detail to admit of identification.

"6. If relief from accountability is granted, the final disposition of the animal will be recorded on both the Bureau's and Auditor's copy of the descriptive list. The former will thereupon be filed with the papers submitted in support of the claim for relief and the latter will remain with the purchase voucher, reference being made thereon to the location or file number of the papers under which relief was accorded.

"7. In case no officer authorized to administer oaths is available certificates may be substituted in lieu of affidavits herein referred to.

"C. H. FRENCH,  
"Insular Auditor."

MANILA, July 29, 1914.

*Constructing Division Circular No. 146.*

SIR: Whenever it is found necessary to forward samples of cement to Manila for the purpose of testing same, the samples should be consigned to the Director of Public Works, Manila, and under no circumstances to the Director of the Bureau of Science which produces delays and confuses the records of this Bureau.

For the Director:

E. J. WESTERHOUSE,  
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,  
HIGHWAY ENGINEER,  
SENIOR SUPERVISING ENGINEERS,  
DEPARTMENT ENGINEER, MINDANAO AND SULU,  
CITY ENGINEER, BAGUIO, and  
Mr. SOLOMON LIBBY, Traveling Inspector, Bureau of Public Works.

MANILA, August 7, 1914.

*Constructing Division Circular No. 147.*

SIR: Attention is invited to the inclosed blank forms which you are directed to accomplish and return *immediately*. It should be noted that one form is for the period ending December 31, 1913, and the other for June 30, 1914. The list must be *complete and correct*, giving the names of all employees whose appointment has, in accordance with law or regulation, or both, been issued or specifically approved by the Director of Public Works. This will include the following positions:

1. Technical positions, such as civil engineers (district and acting district engineers), mechanical and electrical engineers, surveyors, etc., whether temporary or classified; also, positions requiring special skill, such as overseers, inspectors, superintendents of construction, etc., when the appointee has qualified as such for the classified service under civil-service regulations.

2. All clerical positions (including timekeepers, but excluding messengers) whose rate of pay is more than ₱20 per month or ₱240 per annum.

3. Foremen, capataces, carpenters, teamsters, blacksmiths, and all other skilled or semiskilled workmen with compensation exceeding ₱2.40 per day; ₱60 per month or ₱720 per annum. This to include emergency appointments although for a few weeks only.

The information must be correct to such a degree that similar information, if requested later from provincial boards, provincial treasurers, and district auditors, will not be conflicting. *The names of employees in the classified service, if on leave, should be included.*

Do not include common laborers, foremen, capataces, carpenters, teamsters, blacksmiths, skilled or semiskilled workmen, mechanics, or artisans with compensation not exceeding a rate of ₱2.40 per day.

For the Director:

E. J. WESTERHOUSE,  
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,  
HIGHWAY ENGINEER,  
SENIOR SUPERVISING ENGINEERS  
DEPARTMENT ENGINEER, DEPARTMENT OF MINDANAO AND  
SULU, and  
CITY ENGINEER, BAGUIO.

..... District.  
LIST OF BUREAU OF PUBLIC WORKS EMPLOYEES.  
[See Constructing Division Circular No. 147.]

MANILA, September 10, 1914.

Constructing Division Circular No. 148.

....., 191 .  
..... District Engineer.  
For December 31, 1913.

Name.	American. Filipino. Foreigner.	Position.	Compensa- tion.

Fill out immediately and return *original* retaining *duplicate* for office files.

..... District.  
LIST OF BUREAU OF PUBLIC WORKS EMPLOYEES.  
[See Constructing Division Circular No. 147.]

....., 191 .  
..... District Engineer.  
For June 30, 1914.

Name.	American. Filipino. Foreigner.	Position.	Compensa- tion.

Fill out immediately and return *original* retaining *duplicate* for office files.

SIR: It has been found by the Bureau that a bituminous treatment of depressions and overflow sections of roads is more satisfactory, and generally more economical, than the ordinary broken-stone or gravel-macadam surface, as, other conditions being proper, storm waters have scarcely any effect upon a bituminous surface when the ordinary surfacing is, more or less, carried away. And in towns and cities bituminously-treated streets have been found to be very satisfactory through the elimination of the dust nuisance.

It has been found that the satisfactory and economical use of bituminous materials is limited to well-drained subgrades only, and consequently where such drainage does not obtain, or is not obtainable, the application of bituminous materials will not be made.

Therefore, you are directed, if the drainage and financial conditions of your district permit, to requisition so that the requisition may be in this office before October 15, 1914, for such bituminous materials as you will require for the ensuing year. For purposes of calculation, you are advised that for the surface treatment, 0.6 gallons per square meter, and for bituminous macadam 2 gallons per square meter, are necessary. As examples of the above methods, will state that the 17 kilometers of the Manila-South Road near Alabang, Rizal Province, is representative of the surface treatment, and the Bagumbayan Drive, Manila, is representative of the bituminous macadam. The cost per gallon, f. o. b. Manila, should be about ₱0.25 per gallon. Unless the vehicular traffic is greater than 1,500 per twenty-four hours, the surface treatment will be followed. The kind of treatment desired must be stated.

The requisitions should be for one item only, as it is the intention of the undersigned to retain all requisitions of bituminous materials for road purposes until October 15, and then forward them to the Insular Purchasing Agent with specifications. Therefore, you will prepare the requisitions as for a certain number of gallons of Road Oil, the quality to be equal to that specified by the Director of Public Works.

For the Director:

E. J. WESTERHOUSE,  
Chief Constructing Engineer.

To all DISTRICT ENGINEERS,  
HIGHWAY ENGINEER,  
SENIOR SUPERVISING ENGINEERS,  
DEPARTMENT ENGINEER, MINDANAO AND SULU, and  
CITY ENGINEER, BAGUIO.

# APPENDIX B.

## REGISTER NUMBERS, TYPES, AND OWNERS OF MOTOR VEHICLES IN THE PHILIPPINE ISLANDS, JUNE 20, 1914, TO SEPTEMBER 25, 1914.

Register No. and type.	Owner's name.	Register No. and type.	Owner's name.
2941. Tricycle	Walter Saul, Manila.	3135. do	W. G. Hogle, Manila.
2942. Motor cycle	R. B. Edwards, Albay.	3136. do	Francisco Ortigas, Manila.
2943. do	Bureau of Constabulary, Bulacan.	3137. do	Maximo Lichauco, Manila.
2944. do	E. W. Buxton, Occidental Negros.	3138. do	Segundo K. Medina, Manila.
2945. do	Bulacan Province.	3139. Truck	Simmie & Grilk, Manila.
2946. do	Bureau of Internal Revenue, Manila.	3140. Automobile	Juan Teus, Manila.
2947. do	Bureau of Audits, Manila.	3141. Truck	Secundina Rejino, Albay.
2948. Tricycle	Bureau of Constabulary, Batangas.	3142. Automobile	E. Finley Johnson, Manila.
2949. Motor cycle	Peter Klein, Rizal.	3143. do	P. K. Gilman, Manila.
2950. do	Lim Law, Manila.	3144. do	George W. Simmie, Manila.
2951. do	Capiz Province.	3145. do	Mariano B. Arroyo, Iloilo.
2952. do	X. F. Blauvelt, Rizal.	3146. do	Manila Railroad Co., Ltd., Manila.
2953. do	F. C. Seymour Haden, Rizal.	3147. do	Salvador Benedicto, Occidental Negros.
2954. do	Palawan Province.	3148. Truck	Land Transportation, Leyte.
2955. do	Bureau of Education, Pangasinan.	3149. do	Do.
2956. do	Benito Malicsi, Bataan.	3150. Automobile	S. L. Weld, Baguio.
2957. do	Bureau of Forestry, Laguna.	3151. do	H. F. Jeffress, Manila.
2958. do	B. O. Peterson, Pangasinan.	3152. Truck	Compañia "La Union," Leyte.
2959. do	Leyte Province.	3153. Automobile	Jose M. Delgado, Laguna.
2960. do	Bureau of Constabulary, Capiz.	3154. do	Salvador Diy, Manila.
2961. do	Henry E. Smith, Cavite.	3155. Truck	A. L. Ammen, Ambos Camarines.
2962. do	R. B. Sherburne, Leyte.	3156. do	P. B. Artesian Water Co., Rizal.
2963. do	Heradio I. Donado, Iloilo.	3157. Delivery	E. C. McCullough & Co., Manila.
2964. do	Adolfo Monton, Occidental Negros.	3158. Automobile	Quintin Paredes, Manila.
2965. do	Nueva Vizcaya Province.	3159. Delivery	Baltazar Mira, Manila.
2966. do	Eliseo Montinola, Occidental Negros.	3160. Automobile	C. I. Williams, Manila.
2967. do	R. G. Tester, Cavite.	3161. do	S. Feldstein, Manila.
2968. do	Cesar R. Caballer, Manila.	3162. do	Roy A. Brown, Tayabas.
2969. do	Bureau of Constabulary, Pangasinan.	3163. do	Pablo Yaptinchay, Laguna.
2970. do	Frank K. Lempera, Manila.	3164. do	Maria Lechuga, Bulacan.
2971. do	Executive Bureau, Manila.	3165. do	W. E. Gillmore, Rizal.
2972. do	A. L. Ammen, Ambos Camarines.	3166. do	Howard McAustin, Department of Mindanao and Sulu.
2973. do	Felix Montenegro, Oriental Negros.	3167. do	Do.
2974. do	Vela Hermanos, Ambos Camarines.	3168. do	Do.
2975. do	Pedro A. Orin, Pampanga.	3169. do	Vicente V. Gamboa, Occidental Negros.
2976. do	Singer Sewing Machine Co., Bohol.	3170. do	Ramona M. Vda. de Gurrea, Manila.
2977. do	Elias Salem, Leyte.	3171. do	M. Gray Zalinski, Manila.
2978. do	City of Baguio, Baguio.	3172. do	Nieves C. de Jordan, Manila.
2979. do	Walter A. Smith, Manila.	3173. do	R. E. Scott, Samar.
2980. do	Mariano del Olmo, Manila.	3174. do	Figueras Hermanos, Manila.
2981. do	Jos. S. Johnson, Department of Mindanao and Sulu.	3175. do	L. Barkhausen, Laguna.
2982. do	John Gigling, Department of Mindanao and Sulu.	3176. do	Mariano Yulo y Sian, Iloilo.
2983. do	O. F. Frese, Department of Mindanao and Sulu.	3177. do	S. J. Rand, Manila.
2984. do	Samar Province.	3178. do	Olimpia C. Cruz, Bulacan.
2985. do	R. L. Hall, Oriental Negros.	3179. do	Kenneth E. Kern, Batangas.
2986. do	Ramon Caro, Manila.	3180. do	Apolinaria Tabuena, Sorsogon.
2987. do	F. J. Illingworth, Manila.	3181. do	Mariano B. Arroyo, Iloilo.
2988. Reserved for motor to cycles.		3182. do	Ambos Camarines Province.
2999. do		3183. do	P. J. Moore, Department of Mindanao and Sulu.
3094. Automobile	Homer G. Smith, Manila.	3184. do	Bureau of Education, Pangasinan.
3095. do	Luisa de Cantillo, Manila.	3185. do	W. E. Hicks, Manila.
3096. do	Roy J. Berry, Manila.	3186. do	Rex. B. Lockwood, Manila.
3097. do	Monico Barrameda, Albay.	3187. Truck	Philippine Vegetable Oil Co., Manila.
3098. do	Antonio Tantoco, Bulacan.	3188. Automobile	Vda. de R. de Ynchausti, Manila.
3099. do	Rosa Sauz, Manila.	3189. do	Agapito Francisco, Manila.
3100. Truck	Gregorio Peñalosa, Rizal.	3190. do	Felix Marfori, Manila.
3101. do	Do.	3191. do	Jose Ma. Arriola, Manila.
3102. Automobile	E. W. Blair, Manila.	3192. do	H. P. Tinsley, Manila.
3103. do	James Craig Tow, Manila.	3193. do	Dee C. Chuan, Manila.
3104. do	Timoteo Unson, Capiz.	3194. do	Juana U. Vda. de Chuidian, Manila.
3105. do	Rosario Acosta, Manila.	3195. do	E. C. Travis, Manila.
3106. Truck	Compañia "La Union," Leyte.	3196. Truck	Laguna Province.
3107. Automobile	Amando Avanceña, Iloilo.	3197. do	Oriental Brewery & Ice Co., Manila.
3108. do	L. Fred Patstone, Manila.	3198. Automobile	Honorata Fabian, Bulacan.
3109. do	E. J. Westerhouse, Manila.	3199. do	Pedro Picornell, Manila.
3110. do	W. R. Macfarlane, Manila.	3200. Truck	Domingo Oliván, Sorsogon.
3111. do	Edmond Block, Manila.	3201. Delivery	Bureau of Health, Manila.
3112. do	Jesse George, Masbate.	3202. Automobile	Valentina de la Cruz, Rizal.
3113. do	Jack Barber, Manila.	3203. do	Enrique Lopez, Manila.
3114. do	Acrich & Benazra, Samar.	3204. do	Ricardo Garcia Lopez, Manila.
3115. do	Manuel Crescini, Albay.	3205. do	Agustin Alvarez, Manila.
3116. do	E. L. Housley, Pampanga.	3206. do	Richard A. McGrath, Manila.
3117. Truck	Mariano Locsin, Ambos Camarines.	3207. do	Clara Lichauco, Manila.
3118. Automobile	Isidro S. Villarruel, Occidental Negros.	3208. do	H. J. Gallagher, Manila.
3119. do	F. B. Sarabia, Iloilo.	3209. do	Manuel Goles, Occidental Negros.
3120. do	C. Alkan, Manila.	3210. do	Compañia de Transportation de Negros, Occidental Negros.
3121. do	Do.	3211. do	Herederos de Pio Barretto & Co., Manila.
3122. do	Roy J. Berry, Manila.	3212. Truck	Leyte Land Transportation, Leyte.
3123. do	Pangasinan Province.	3213. Automobile	Leon P. Rustia, Bulacan.
3124. do	Rafael del Pan, Manila.	3214. do	Francisco Latorre, Samar.
3125. do	Joaquin Mendez, Ambos Camarines.	3215. do	Alexander McCulloch Stewart, Iloilo.
3126. do	Vicente Monroy, Manila.	3216. do	Julio Javellana, Iloilo.
3127. do	Alejandro Montelibano Ramos, Occidental Negros.	3217. Truck	I. M. Parkinson, Department of Mindanao and Sulu.
3128. do	M. B. Arroyo, Iloilo.	3218. do	Lutz & Co., Manila.
3129. do	Bartolome Vaquer, La Union.	3219. Delivery	St. Louis Bakery, Manila.
3130. do	O. E. Hert, Manila.	3220. Automobile	Simon Khamiger, Iloilo.
3131. do	Wm. H. Steinman, Laguna.	3221. do	Bureau of Education, Tayabas.
3132. do	Jose Yulo, Iloilo.	3222. Truck	Leyte Land Transportation, Leyte.
3133. Truck	Clum & Martensen, Department of Mindanao and Sulu.	3223. Reserved for	Ariston Bautista, Manila.
3134. Automobile	D. C. Cubbison, Rizal.	3224. Automobile	Petronilo del Rosario, Manila.
		3225. do	Enrique R. de la Cruz, Bulacan.



# APPENDIX C.

## PROJECTS ACTIVE JULY 1, 1914.

Provinces.	Roads and trails.				Bridges and culverts.				Provincial administration buildings.			Municipal administration buildings.			Prisons.			Schools.				Construction and operation.										Total.	
	Construction.	Maintenance.	Repair.	Reconstruction.	Construction.	Maintenance.	Repair.	Reconstruction.	Construction.	Maintenance.	Repair and alteration.	Construction.	Reconstruction.	Maintenance.	Construction.	Repair and alteration.	Maintenance.	Construction.	Maintenance.	Repair and alteration.	Reconstruction.	Markets.	Parks, grounds, and athletic fields.	Miscellaneous buildings.	Ferries.	Water systems.	Record vaults.	Quarries.	Telephone lines.	Electric-light plants.	Miscellaneous.		
Albay	3	2			6	2		1		1		4						7	1			6		1							4	38	
Ambos Camarines	2	2		2	6	1																2	1	1								29	
Antique	1	2		1	4					1								1	1												2	14	
Bataan	1	3		3	2			1																							1	11	
Batangas	6	4				1				1		1						6	2		2	3			1						1	31	
Bohol	1	3		2	6													2			2											17	
Bulacan	4	3		1														3				1										13	
Cagayan	3	3		1		1				1						1				1					1						5	18	
Capiz	3	3		1						1								4					2	1	1						1	17	
Cavite	5	2																1														8	
Cebu	7	2	1			1												7				5		1		1					3	28	
Ilocos Norte	1	2			3			1			1							6			1											16	
Ilocos Sur	12	3	1		3	1							2					13							2						3	40	
Iloilo	5	3	2		3		1											1		1			1			1					3	21	
Isabela	3	5			3													1					2									14	
Laguna	2	2	3	4	1			1										8		1		4							2		1	27	
La Union	7	4			3													6				2	1		1						1	25	
Leyte	3	2			5													2				2		1								15	
Misamis	2	4			3													2														12	
Nueva Ecija	3	2			5													6					1		1	1					1	20	
Occidental Negros	12	2			2													4				1									5	27	
Oriental Negros	4	4			1	2			2									4				2				1						3	23
Pampanga	2	3			2			1										2			1	1										1	15
Pangasinan	7	4		1	6	1						2	5					10		1	1	9	3		2	1					12	64	
Rizal	2	6		7	1					2								1	1													2	27
Samar	3	2		1	1													1		1		1	1	4							3	15	
Sorsogon	3	2			3													1														5	14
Surigao	2	2																4		3												11	
Tarlac	2	3			1							1						1				2									1	14	
Tayabas	3	3			2					1								5		1		1	1			2						19	
Zambales		2			14					1								1								1					2	21	
Total	119	95	7	23	89	10	1	5	2	9	1	8	7			3		114	6	8	5	41	13	16	9	9			3	1	60	664	

Projects numbering 60 under the caption "Miscellaneous" represent 20 surveys and investigations of roads, bridges, water systems, rivers, etc., 3 harbor maintenance, 1 wharf, 3 dikes, 2 river controls, 1 irrigation system, 1 auto line operation, 1 fence construction, etc.

# BUREAU OF PUBLIC WORKS

## ORGANIZATION

**WARWICK GREENE**, *Director of Public Works*

**G. C. FENHAGEN**, *Consulting Architect*

**W. L. GORTON**, *Chief Designing Engineer*

**H. F. CAMERON**, *Department Engineer, Mindanao and Sulu*

**C. LINDSEY**, *Assistant to the Director*

**WILLIAM HIRZEL**, *Chief Accountant*

**O. K. OLSEN**, *Property Clerk*

**E. S. GEE**, *Record Clerk*

**A. K. JONES**, *Law Clerk*

**L. L. COOK**, (absent), *Superintendent Automobiles*

## CONSTRUCTING DIVISION

**E. J. WESTERHOUSE**, *Chief Constructing Engineer*

**C. E. GORDON**, *Highway Engineer*

**W. H. WAUGH**, *Senior Supervising Engineer*

**B. VON SCHMELING** (absent), *Senior Supervising Engineer*

**D. E. HENRY**, *Senior Supervising Engineer*

**J. W. VICKERS** (absent), *Superintendent Artesian Wells*

## DISTRICT ENGINEERS

Brown, E. C..... Albay, Albay  
Dandois, Chas. S..... Naga, Ambos Camarines  
Baluyot, Sotero..... San Jose, Antique  
Williams, A. D..... Baguio, Benguet  
Francisco, Luis..... Balanga, Bataan  
Caton, J. H. 3d..... Batangas, Batangas  
Harrison, J. L..... Malolos, Bulacan  
Boggess, L. S..... Tagbilaran, Bohol  
Barry, R. L..... Tuguegarao, Cagayan  
Bennett, C. R..... Cavite, Cavite  
Sjovall, A. H..... Capiz, Capiz  
Russell, Claud..... Cebu, Cebu  
Glenn, R. V..... Iloilo, Iloilo  
Honska, W. B..... Laoag, Ilocos Norte  
Smith, E. D..... Vigan, Ilocos Sur  
Gomez, Pastor..... Ilagan, Isabela  
McComb, D. Q..... San Fernando, La Union

Barry, J. R..... Los Baños, Laguna  
Clark, L. T..... Tacloban, Leyte  
McGregor, J..... Manila  
Allen, R. N..... Cagayan, Misamis  
Austin, A. W..... Cabanatuan, Nueva Ecija  
McGlathery, S. L..... Bacolod, Occidental Negros  
Grosvenor, I. R..... Dumaguete, Oriental Negros  
Halsema, E. J..... San Fernando, Pampanga  
Morrison, C. G..... Lingayen, Pangasinan  
Brown, L. R..... Pasig, Rizal  
Baugh, N. R..... Catbalogan, Samar  
Lilley, H. B..... Sorsogon, Sorsogon  
Meehleib, H. R..... Surigao, Surigao  
Agcaoili, Romarico... Tarlac, Tarlac  
Miles, H. V..... Lucena, Tayabas  
Vallarta, Julian..... San Narciso, Zambales